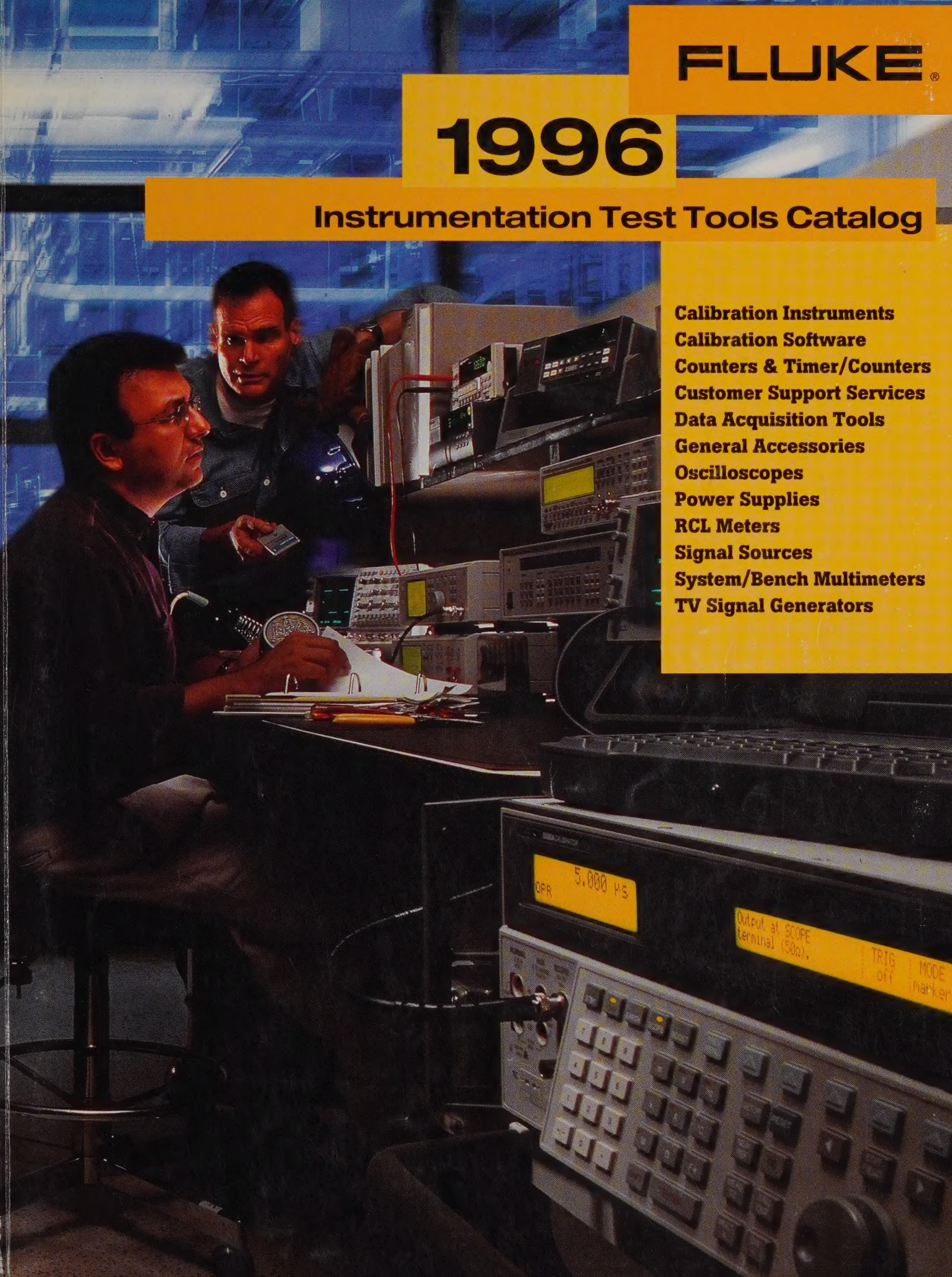
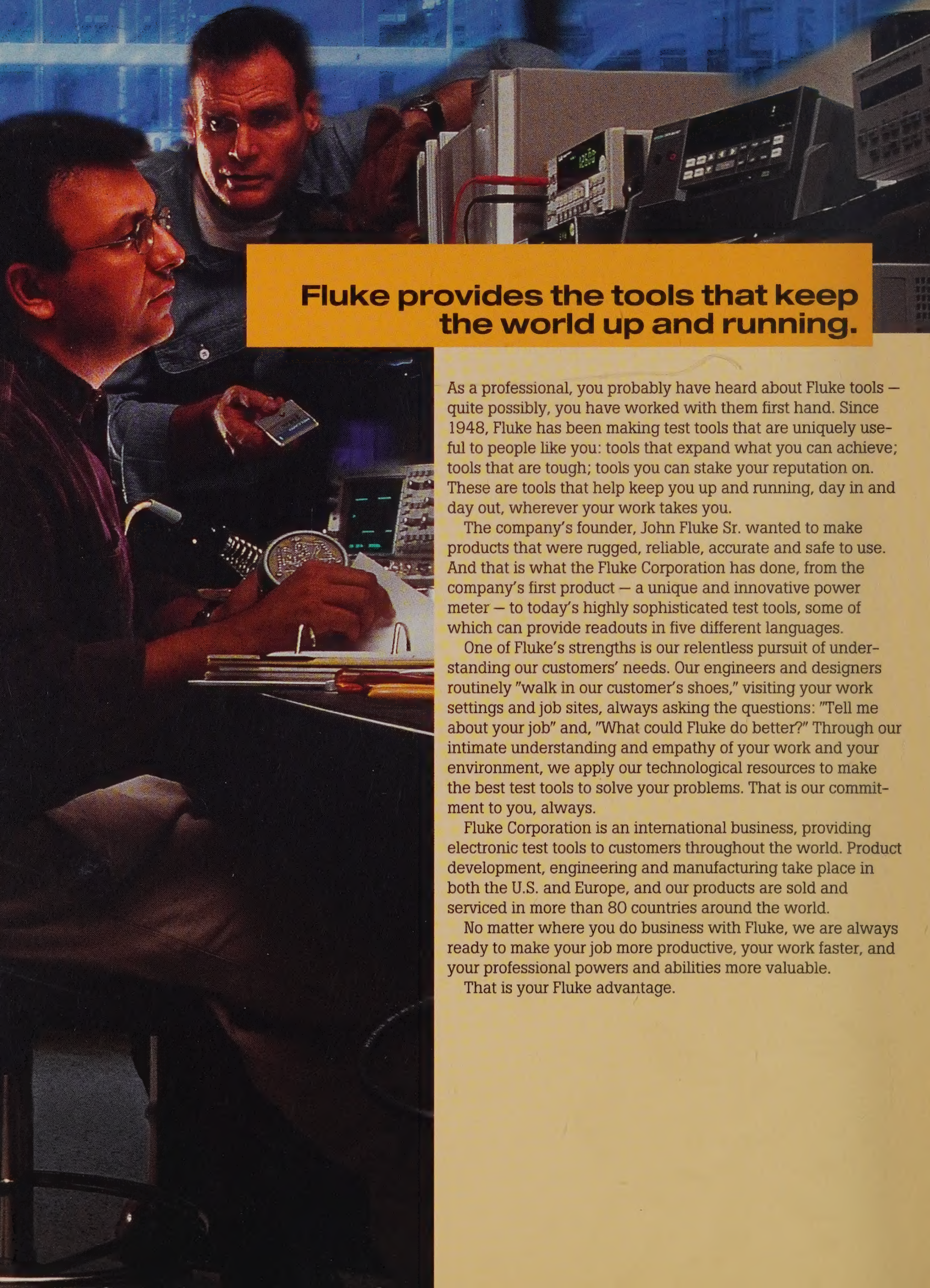
FLUKE®

# 1996

# Instrumentation Test Tools Catalog


5.000 µs
OPR
Output at SCOPE terminal (50Ω).
TRIG off
MODE marker

- Calibration Instruments
- Calibration Software
- Counters & Timer/Counters
- Customer Support Services
- Data Acquisition Tools
- General Accessories
- Oscilloscopes
- Power Supplies
- RCL Meters
- Signal Sources
- System/Bench Multimeters
- TV Signal Generators



# Fluke provides the tools that keep the world up and running.

As a professional, you probably have heard about Fluke tools — quite possibly, you have worked with them first hand. Since 1948, Fluke has been making test tools that are uniquely useful to people like you: tools that expand what you can achieve; tools that are tough; tools you can stake your reputation on. These are tools that help keep you up and running, day in and day out, wherever your work takes you.

The company's founder, John Fluke Sr. wanted to make products that were rugged, reliable, accurate and safe to use. And that is what the Fluke Corporation has done, from the company's first product — a unique and innovative power meter — to today's highly sophisticated test tools, some of which can provide readouts in five different languages.

One of Fluke's strengths is our relentless pursuit of understanding our customers' needs. Our engineers and designers routinely "walk in our customer's shoes," visiting your work settings and job sites, always asking the questions: "Tell me about your job" and, "What could Fluke do better?" Through our intimate understanding and empathy of your work and your environment, we apply our technological resources to make the best test tools to solve your problems. That is our commitment to you, always.

Fluke Corporation is an international business, providing electronic test tools to customers throughout the world. Product development, engineering and manufacturing take place in both the U.S. and Europe, and our products are sold and serviced in more than 80 countries around the world.

No matter where you do business with Fluke, we are always ready to make your job more productive, your work faster, and your professional powers and abilities more valuable.

That is your Fluke advantage.

FLUKE®

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## How to use this catalog

Your Fluke catalog is organized in sections, each with its own title and number as shown in the table of contents on this page. For easy reference, the top of each page in a section will show the section title. The number of the section will also appear on the outer page margin.

The catalog begins with an introductory overview of new and highlighted products, along with page numbers to direct you to the product sections where full descriptions and specifications will be found. The product sections typically begin with a selection guide that compares key features and specifications of the products within the section. Product pages usually begin with a photograph of the product, together with a summary listing of key specifications and features. Following that is a thorough presentation of the product's features and benefits, together with technical and general product specifications, and ordering information.

Alphabetical and numerical indexes are found at the end of the catalog. In addition to these indexes, you will find a listing of other test tools available from Fluke, together with an overview of other catalogs offered by Fluke. A handy call guide is printed on the inside back cover to help direct you to the right resource for further information.

Thank you for considering Fluke. We hope this catalog helps you select the Fluke tools that are right for you. We look forward to the opportunity of working with you.

# Product Highlights

Again this year, the Fluke Corporation offers a comprehensive and useful array of new and popular products — the best in the electronic test tools industry.

Many of these products are new; others are some of our current best sellers. Some are augmented by advanced features and functions.

While the products on these pages represent a wide variety of uses, forms, features and functions, all Fluke tools have characteristics that are unique and recognizable:

- Each Fluke tool is accurate and provides precise information. They reflect the professionalism of the people who buy and use them.
- Each is reliable, dependable, and rugged. Fluke tools are designed and built to withstand the rigors of the workplace, and each tool is carefully designed to protect the user. When the going gets tough, Fluke tools keep going.
- Fluke tools are easy to operate. Many owners of Fluke tools say that the controls of their instruments are intuitive, and are designed to help speed up their work.
- Fluke test tools are compact and easily transported, but they don't stint on function. Many Fluke tools have multiple functions. They are easily serviced and customer support is just a phone call away, whether you're in a major city or a tiny town.
- Finally, Fluke tools are always a good value, particularly compared against other tools for their cost/function ratio. Fluke makes the tools that the professionals buy — and keep.

Whether the Fluke tool is an entirely new product, an upgraded high-performer or a classic "must-have", Fluke products continue to be the leaders in the electronic test field. Some of the best-of-the-best are shown on these pages.

5500A CALIBRATOR
1000.00 V
STBY 11.0000 A
HARMONIC V WAVE I WAVE "LO"s PHASE
MENUS sine sine tied 0.00
NORMAL
AUX
SCOPE
TRIG OUT
ENTER
SHIFT
POWER

## Calibrators

**New Product**

### 5500A Multi-product Calibrator

- The first multi-product calibrator
- 11 Calibrators in one
- Affordable wide workload coverage, including oscilloscopes
- Easy to use, portable, rugged
- Calibrates direct and alternating voltage, current and power, temperature, capacitance, plus oscilloscope bandwidth, risetime, time marks and more
- Optional software tools offer a complete solution to calibration management and documentation

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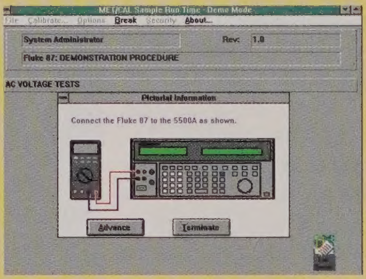
MET/CAL Sample Run Time - Demo Mode
File Calibrate Options Break Security About...
Advance
Terminate

System Administrator Rev: 1.0

Fluke 87: DEMONSTRATION PROCEDURE

AC VOLTAGE TESTS

Pictorial Information

Connect the Fluke 87 to the 5500A as shown.

## Calibration Management Software

**New Feature**

### MET/CAL®

- A powerful, flexible, full-featured automated calibration system
- Supports today's quality programs like ISO 9000
- Documents procedures, results, traceability and adequacy
- More than 300 procedures included
- Compatible with MET/TRACK®
- Flexible and easy to use. Backed by MET/SUPPORT®

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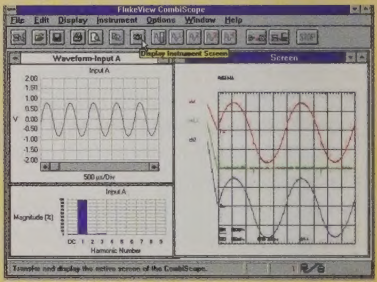
FlukeView CombiScope
File Edit Display Instrument Options Window Help
Display Instrument Screen
Waveform-Input A
Input A
Screen
500 µs/Div
Input A
Magnitude (%)
Harmonic Number

Transfer and display the entire screen of the CombiScope.

## FlukeView™ CombiScope™ Software

**New Product**

- Capture complete screen images or waveforms
- Store the captured screen images or waveforms in popular PC file format for later retrieval
- Use waveform data in spreadsheet programs for detailed analysis or graphical output
- Analyze harmonics of a waveform, determine the spectrum using FFT analysis
- Compare acquired waveforms with stored waveforms
- Save and retrieve set-ups
- On line context sensitive help always available

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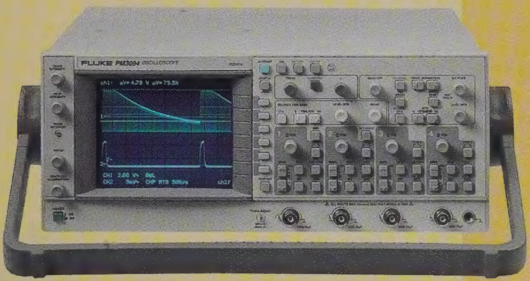
# Product Highlights



## Oscilloscopes

### Analog Oscilloscope

**PM 3094**
- Autoset for automatic amplitude, time and trigger setting
- 16 kV CRT acceleration voltage
- GPIB/IEEE-488 interface option
- High reliability: 3-year warranty, 5 year CRT warranty

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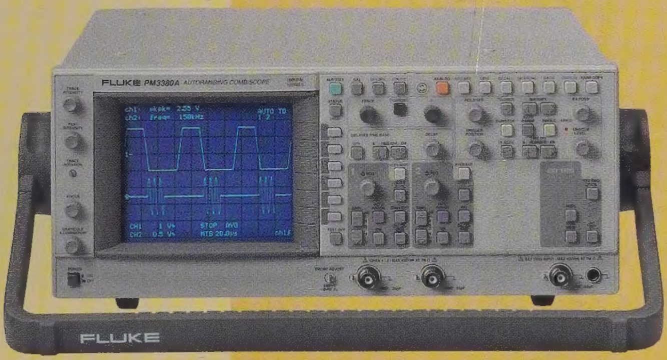

New Feature

**PM 3370A**
**PM 3390A**
**PM 3380A**
**Combiscopes**
- Combined digital storage and analog oscilloscope performance in one instrument
- Autoranging for hands-free operation
- Up to 200 MS/s sample rate
- 60 MHz, 100 MHz or 200 MHz analog and digital bandwidth
- Continuously variable timebase in digital and analog mode
- Up to 32K acquisition memory for storage of more than 200 traces
- Extensive TV and logic triggering
- Extensive mathematical functions
- RS-232 interface standard

See page 12

8842A MULTIMETER
18.0001

## Bench/System Multimeters

### 8842A 5½-Digit Multimeter
- 0.003% basic 1 year dc accuracy
- Ohms and dc current standard – ac voltage and current optional
- Full system capability with optional GPIB/IEEE-488 interface
- Up to 100 readings/second system speed
- Easy-to-use front panel
- Vacuum fluorescent display
- Closed-case calibration – comprehensive self-test
- Increased resolution with 20 mV, 200 mA, and 20Ω ranges
- Extended calibration cycle with 2 year specifications

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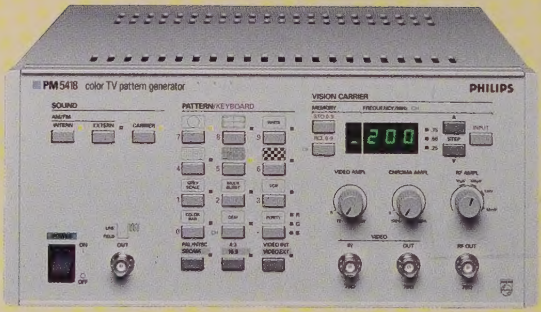
# Product Highlights

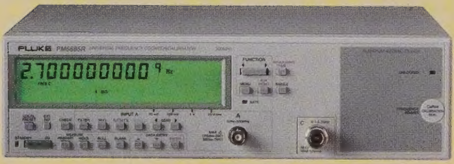

PM 5418 color TV pattern generator
PHILIPS
SOUND
PATTERN/KEYBOARD
VISION CARRIER
VIDEO AMPL
CHROMA AMPL
RF AMPL
POWER

## TV Signal Generators

**New Product**

### PM 5400 Family
### PM 5420

- PALplus Test Capability
- Over 100 video test patterns for PAL, NTSC and SECAM video standards
- 16:9 and 4:3 aspect ratio patterns
- Special patterns for VCR and 100 Hz IDTV (Improved Definition TV) testing
- Mono, stereo, NICAM and MTS Stereo plus SAP (BTSC) sound test signals
- Teletext TOP/FLOF, VPT and Antiope test signals
- Closed Caption test signals
- GPIB/IEEE-488 programmable
  See page 185

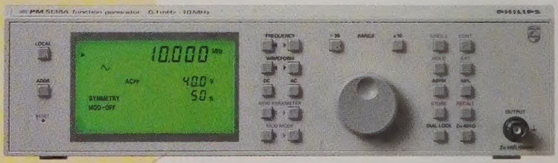

FLUKE PM6685R
2.700000000

## Rubidium Timer/Counters

**New Product**

### PM 6685R
### PM 6681R

- High accuracy and short warm up times:
  1 x 10-9 within <6 min
  1 x 10-10 within <30 min
- Ageing 2 x 10-10 per year
- Calibrates any application specific frequency
- 5 year warranty on Rubidium element
- 300 MHz range, optional to 4.5 GHz
- 10 MHz reference output
  See page 93


PHILIPS
10.000
SYMMETRY
MOD-OFF

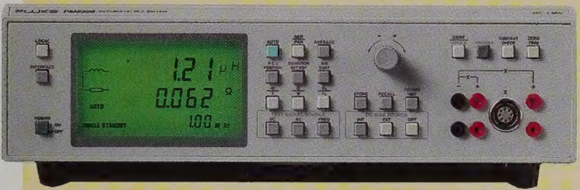
## Function Generators

**New Feature**

### PM 5139
### PM 5138A

- Large backlit LCD display and menu controlled operation
- Frequency range from 0.1 mHz to 20 MHz (PM 5139) or 10 MHz (PM 5138A)
- 20 Vp-p Output (PM 5139) or 40 Vp-p Output (PM 5138A)
- 10 standard waveforms (PM 5139) or 7 standard waveforms (PM 5138)
- Arbitrary waveforms on instruments with GPIB/IEEE-488.2 interface
- Programmable internal trigger/modulation source 1 mHz to 100 kHz (PM 5139)
- 50Ω or 600Ω output impedance (PM 5138A)
- Internal/external modulation modes include AM, FM, PSK, Sweep, Burst, and Gate
  See page 172

# Product Highlights



## Automatic RCL Meters

**New Product**

**PM 6306**
**PM 6304**

- Programmable test frequencies from DC to 1 MHz
- 0.1% basic measurement accuracy
- DC resistance measurements (optional)
- RS-232 and GPIB/IEEE-488 interfaces
- AC and DC test levels from 50 mV rms to 2V rms
- Up to 10V internal DC bias and external bias to 40 VDC
- 9 front panel setups in memory; recall last setup on power up
- Actual component test voltage/current readback
- Deviation mode to display measurements as tolerance percentage

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## Signal Sources

**New Product**

**PM 5136**

- Economy 5 MHz Function Generator
- Low budget, high performance synthesizer
- Large backlit display and easy menu controlled operation
- Choice of 7 standard waveforms, includes, sine, triangle, square, positive pulse, negative pulse, positive sawtooth and negative sawtooth
- Symmetry continuously variable
- Internal and external modulation modes, includes AM, FM, Linear Sweep, Logarithm Sweep and Burst
- 9 setting memories
- GPIB/IEEE-488.2 interface (optional)

See page 170

## High Speed Data Acquisition Tools

**New Product**

**NetDAQ**
**(2640A & 2645A)**

- High speed data acquisition, up to 1,000 readings per second
- 20 analog input channels expandable up to 400 channnels
- Extensive optional plotting and trending capabilities
- Optional wall, cabinet, or rack mounting
- May be connected to Ethernet networks

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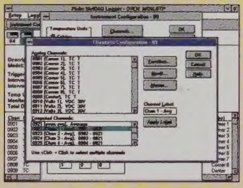

## Data Acquisition Software

**New Product**

**NetDAQ Logger for Windows**

- Windows® based application software for 2640A and 2645A NetDAQ mainframes
- No programming required
- Easy menu-based configuration – Quickly configure and start data collection
- Extensive plotting and trending capabilities
- Exchange data with other Windows programs in real time with DDE
- Intuitive interface through its Windows interface

See page 111

## Hydra Logger for Windows® Software

**New Product**

- True Microsoft Windows package
- Supports the 2625A and 2635A Hydra models
- Supports 40 channels — two Hydra instruments
- Extensive optional plotting and trending capabilities
- Full DDE (Dynamic Data Exchange)
- Multiple language support (English, German, French and Spanish)
- Intuitive interface
- On-line help

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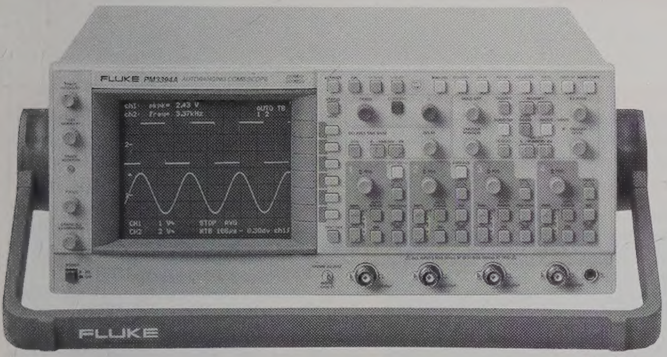
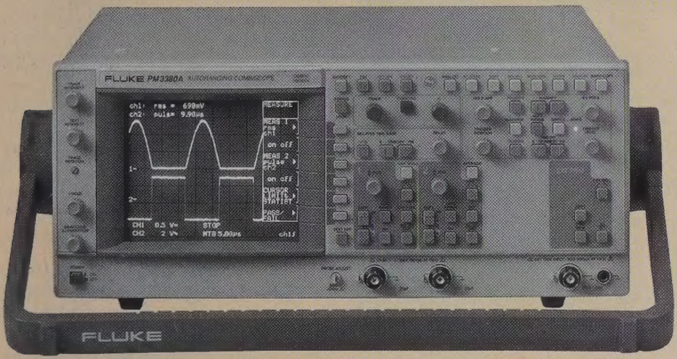
45279

# Oscilloscopes



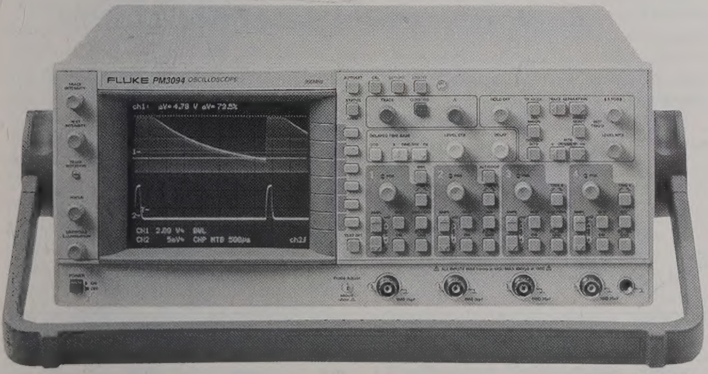
PM 3394A

**New Feature**



PM 3380A

**New Feature**



PM 3094

The oscilloscopes in this section address many of the measurement and signal viewing needs in R&D, Production, Service and Training applications.

There are 8 analog models with bandwidths up to 200 MHz.

There is a choice of 13 CombiScope™ models offering the best of both worlds: Analog display, ease of use and familiarity combined with powerful Digital Storage Oscilloscope (DSO) performance in one instrument. Switch between analog and DSO operation at the touch of a button.

Some of these CombiScopes include a new feature that enables hands-free operation. Autoranging gives the oscilloscope the capability to adapt itself continuously to the signals applied. So, every time a new testpoint is probed, the scope immediately adapts its timebase and attenuator without the need to make any manual changes to the oscilloscope settings.

All Fluke oscilloscopes in this catalog include Autoset. This function selects the proper channels and trigger conditions, sets the proper amplitude, and selects a timebase speed to match the signal under test.

Most of these CombiScopes are available with IEEE-488 interface, RS-232 interface, or both; for many, the RS-232 interface is standard.

All combiscopes are supported by a range of software packages for easy documenting and archiving of measurements.

Finally, the oscilloscope section includes a range of accessories to make these oscilloscopes match almost every application, ranging from measuring voltages, to analyzing the frequency spectrum of the current in a system.

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Page 39

# Oscilloscopes

## CombiScopes Selection Guide

| Model | Bandwidth (Rise Time) | Sample Rate Real time/ Equivalent Time | Max. Acquired Signal frequency | Ch. | Auto-ranging | Acquisition Memory | Ref. Mem. | Vertical Resolution (with Averaging) | Cursors | Math | RS-232/ GPIB | Page |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PM 3394A | 200 MHz<br>(1.75 ns) | 200 MS/s<br>25 GS/s | 200 MHz | 4 | Yes | 8K<br>32K optional | 3*8K<br>3*32K optional | 8<br>(14) | Yes | Yes + opt. | Stand.<br>/Option | 12 |
| PM 3392A | 200 MHz<br>(1.75 ns) | 200 MS/s<br>25 GS/s | 200 MHz | 2+2 | Yes | 8K<br>32K optional | 3*8K<br>3*32K optional | 8<br>(14) | Yes | Yes + opt. | Stand.<br>/Option | 12 |
| PM 3390A | 200 MHz<br>(1.75 ns) | 100 MS/s<br>25 GS/s | 200 MHz | 2+1 | Yes | 2*4K<br>2*16K optional | 3*8K<br>3*32K optional | 8<br>(14) | Yes | Yes + opt. | Stand.<br>/Option | 12 |
| PM 3384A | 100 MHz<br>(3.5 ns) | 200 MS/s<br>10 GS/s | 100 MHz | 4 | Yes | 8K<br>32K optional | 3*8K<br>3*32K optional | 8<br>(14) | Yes | Yes + opt. | Stand.<br>/Option | 12 |
| PM 3382A | 100 MHz<br>(3.5 ns) | 200 MS/s<br>10 GS/s | 100 MHz | 2+2 | Yes | 8K<br>32K optional | 3*8K<br>3*32K optional | 8<br>(14) | Yes | Yes + opt. | Stand.<br>/Option | 12 |
| PM 3380A | 100 MHz<br>(3.5 ns) | 100 MS/s<br>10 GS/s | 100 MHz | 2+1 | Yes | 2*4K<br>2*16K optional | 3*8K<br>3*32K optional | 8<br>(14) | Yes | Yes + opt. | Stand.<br>/Option | 12 |
| PM 3370A | 60 MHz<br>(5.8 ns) | 100 MS/s<br>10 GS/s | 60 MHz | 2+1 | Yes | 2*4K<br>2*16K optional | 3*8K<br>3*32K optional | 8<br>(14) | Yes | Yes + opt. | Stand.<br>/Option | 12 |
| PM 3375 | 100 MHz<br>(3.5 ns) | 250 MS/s<br>2.5 GS/s | 100 MHz | 2 | Autoset | 4K | 12K | 8 | Yes | No | optional | 20 |
| PM 3365A | 100 MHz<br>(3.5 ns) | 100 MS/s<br>2.5 GS/s | 100 MHz | 2 | Autoset | 4K | 12K | 8 | Yes | No | optional | 20 |
| PM 3355 | 60 MHz<br>(5.8 ns) | 250 MS/s<br>---- | 25 MHz | 2 | Autoset | 4K | 12K | 8 | Yes | No | optional | 20 |
| PM 3350A | 60 MHz<br>(5.8 ns) | 100 MS/s<br>---- | 10 MHz | 2 | Autoset | 4K | 12K | 8 | Yes | No | optional | 20 |
| PM 3335 | 60 MHz<br>(5.8 ns) | 20 MS/s<br>---- | 2 MHz | 2 | Autoset | 8K | 8K | 8 | Yes | No |  | 22 |
| PM 3331 | 40 MHz<br>(8.75 ns) | 20 MS/s<br>---- | 2 MHz | 2 | Autoset | 8K | 8K | 8 | Yes | No |  | 22 |

## Analog Scopes Selection Guide

| Model Number | Bandwidth (Rise Time) | Channels | Max. Time Base Sweep | Trigger Bandwidth | Acceleration Voltage | Dual Time Base | Cursors | RS-232 | GPIB | Autoset | Page |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PM 3094 | 200 MHz<br>(1.75 ns) | 4 | 2 ns/div | 300 MHz | 16.5 kV | Yes | Yes | Yes | opt. | Yes | 25 |
| PM 3092 | 200 MHz<br>(1.75 ns) | 2+2 | 2 ns/div | 300 MHz | 16.5 kV | Yes | Yes | Yes | opt. | Yes | 25 |
| PM 3084 | 100 MHz<br>(3.5 ns) | 4 | 5 ns/div | 200 MHz | 16.5 kV | Yes | Yes | Yes | opt. | Yes | 25 |
| PM 3082 | 100 MHz<br>(3.5 ns) | 2+2 | 5 ns/div | 200 MHz | 16.5 kV | Yes | Yes | Yes | opt. | Yes | 25 |
| PM 3070 | 100 MHz<br>(3.5 ns) | 2+1 | 5 ns/div | 150 MHz | 16 kV | Yes | Yes | opt. | opt. | Yes | 29 |
| PM 3065 | 100 MHz<br>(3.5 ns) | 2+1 | 5 ns/div | 150 MHz | 16 kV | Yes | No | opt. | opt. | Yes | 29 |
| PM 3055 | 60 MHz<br>(5.8 ns) | 2+1 | 5 ns/div | 100 MHz | 16 kV | Yes | No | opt. | opt. | Yes | 29 |
| PM 3050 | 60 MHz<br>(5.8 ns) | 2 | 5 ns/div | 100 MHz | 16 kV | No | No | opt. | opt. | Yes | 29 |

# Oscilloscopes

## Introduction

Oscilloscopes are available from a wide variety of sources and manufacturers. During the last few years, many oscilloscope manufacturers and users have contributed to a transition from the traditional and trusted Analog Oscilloscope to the more powerful, but also more complex, Digital Storage Oscilloscope (DSO). Many applications benefit from this transition, but not all. The reason for this is the fact that not all signals take kindly to the process of sampling, digitizing, and storing the analog information present in the signals under test. It is for this reason, that Fluke is committed to offering the best value in the best of both worlds: Oscilloscopes combining the functions of powerful digital storage oscilloscopes and complete analog instruments in one case. This catalog describes one of the widest choices of such CombiScopes™ available from any manufacturer. This range starts with the 40 MHz, 20 MS/s PM 3331, up to the 200 MHz, 200 MS/s PM 3394A. There are a total of 13 models of CombiScopes to choose from!

In addition, this catalog includes a full line of easy to use analog oscilloscopes with bandwidths of up to 200 MHz in the powerful, four channel, PM 3094.

### Analog, Digital or Both?

Although digital oscilloscopes marked a significant breakthrough in signal monitoring, many situations still call for analog oscilloscopes. Pure digital storage or pure analog scopes provide only part of the answer when dealing with complex signals or more thorough waveform analysis. Combination analog/digital oscilloscopes known as CombiScopes are the obvious single scope solution.

They also facilitate the introduction of digital technology to what was formerly a purely analog world. Many users simply feel more comfortable with the familiarity and ease-of-use associated with analog systems. Both analog and digital have their advantages; the real time capabilities of analog cannot be matched by digital scopes, yet digital scopes are unrivalled for pre-trigger viewing and providing consistent high-brightness for fast sweeps and single shot or low repetition rate signals.

This introduction discusses the merits of combined analog and digital capabilities in a CombiScope, making a comparative study of how several different types of signals are handled in both analog and digital modes. With the exception of Figure 4, the screen photographs are taken from the PM 3394A family of CombiScopes.

### Reproducing Simple Repetitive Signals

Figure 1 shows the analog trace of a fast rising edge. Figure 2 shows the same signal, on the same CombiScope, but using digital storage mode. There is little difference between the two, and both signals can be easily measured. At first glance, the choice between analog and digital modes does not seem crucial.

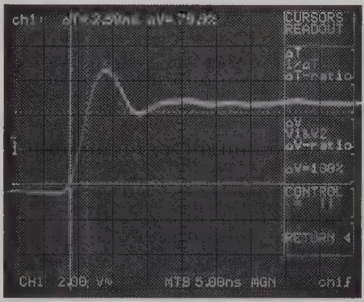


Fig. 1. Analog trace of a fast rising edge.

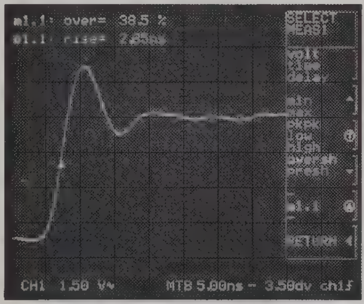


Fig. 2. The same rising edge when viewed in digital storage mode.

The digital trace, however, is constructed using repetitive sampling, a process deployed by almost all digital storage oscilloscopes to monitor fast signals of this type. This entails building up the trace over repeated occurrences of the waveform, with each progressive acquisition used to modify the previous trace. Consequently, if the signal changes, it can take several seconds before a sufficient number of samples have been taken to reconstruct the waveform. This creates a time lag between user adjustment and the new signal appearing on screen.

The analog display, on the other hand, is real time. If the signal changes, the display responds instantly. Therefore, for frequently changing signals, analog mode of the CombiScope is more suitable.

### Analyzing Composite Video Signals

The composite video signal is an example of a complex modulated analog signal. When viewed in analog mode, the intensity of the various signal elements provides a great deal of information to the trained eye concerning the nature of the waveform and therefore the performance of the system. Figure 3 shows a composite video signal as an analog trace. The color modulation can be clearly seen, and the time distribution of the waveform is also evident.

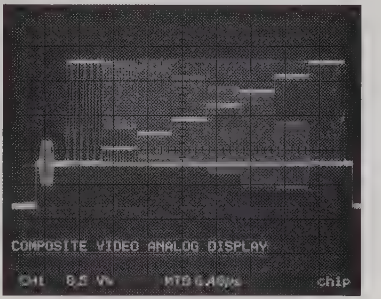


Fig. 3. Composite video signal using analog mode.

Given the complexity of the signal, sampling and digital reconstruction do not produce a display with nearly the same amount of information as analog mode. This is demonstrated in Figure 4, a typical raster scan CRT display of the same waveform on a digital only oscilloscope. Even though certain digital scopes have two or more intensity levels, limitations of screen resolution and of the intensity itself means an analog signal display is still preferable.

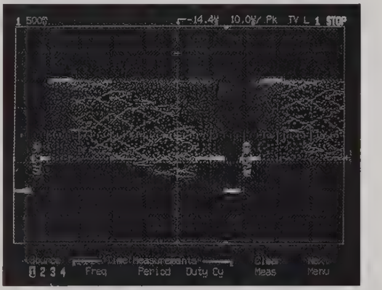


Fig. 4. Stored composite video signal as reproduced on a purely digital scope.

To analyze specific parts of the waveform, however, digital reconstruction can be advantageous. The color burst in the video signal has a frequency of around 4 MHz and at the same time has a relatively low repetition rate, especially when viewing a single selected line. This is not a problem for digital scopes, which display the waveform with a uniform intensity. Figure 5 shows the color burst of a single line of a video signal, as displayed in digital storage mode. Analog scopes can encounter intensity problems in reproducing such signals, as the signal is not present long enough to give high brightness on the CRT.

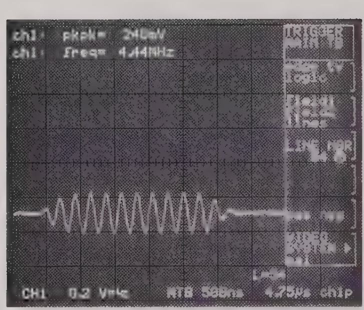


Fig. 5. Color burst on a line of a video signal, using digital storage mode.

## Locating Glitches Using Digital Peak Detection

When viewing a complete waveform in analog mode, short duration spikes or "glitches" are impossible to see. This is demonstrated in Figure 6, which shows a staircase waveform that has glitches deliberately added.

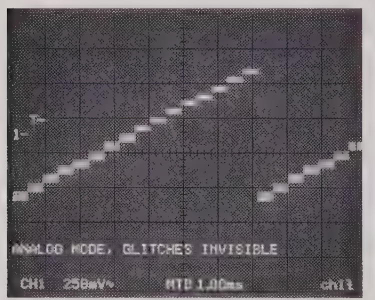


Fig. 6. Repetitive staircase signal with added glitches viewed in analog mode, with the glitches invisible.

Digital mode has a facility known as peak detection, which detects and displays such glitches. The result can be seen in Figure 7, a digital representation of the same waveform as was used in Figure 6.

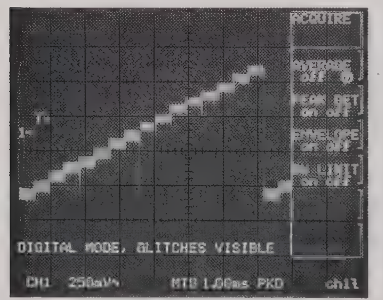


Fig. 7. The same staircase signal when viewed in digital storage mode, with visible glitches

When an oscilloscope has dual time base facilities, such waveforms can be analyzed in great detail. Figure 8 is an example of this, using intelligent triggering to clearly show the 165 nanosecond spikes.

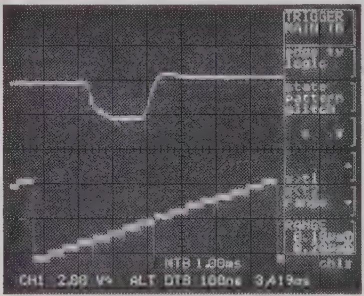


Fig. 8. Dual time base display of the staircase signal, in digital storage mode.

The advent of digital technology has made it possible to view signals that were previously difficult to monitor due to cost and logistical constraints. Often UV recorders, digitizers, tube storage scopes, cameras and long persistence tubes were necessary. Furthermore, events that happen only once can not normally be registered on an analog scope. Using the digital facilities on a CombiScope™, these unique events can be digitized, stored for recall, and subsequently analyzed by computer or fed to a hard copy device.

## Multi-Channel Capabilities

This capability can be extended to more than one channel. A number of four channel digital storage oscilloscopes can trigger on a pattern or a combination of logic states at the inputs. This has obvious attractions to hardware engineers.

Digital storage scopes are designed so the trigger stops data acquisition. If the trigger point is set in the middle of the memory, the signal preceding the trigger point is also stored. This is beyond the capabilities of an analog scope, which at best can display a few nanoseconds on higher bandwidth models with delay lines - and even then only by using photography for single shots.

Pre-trigger information can often be of great importance. In Figure 9 the transient voltage caused by tapping a standard BNC connector on a bench is shown. The trigger point is level with the "T" on the first large positive going edge. Using digital storage shows clearly that the first major peak in the transient was negative.

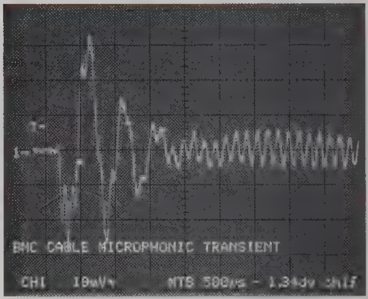


Fig. 9. Digital trace of a transient voltage in a BNC connector, with trigger point and pre-trigger waveform shown

## Waveform Analysis Using CombiScope

Once the optimum mode has been selected to display the waveform, CombiScopes can be used to extract a tremendous amount of information. Analog waveforms can be measured for voltage and time changes using cursors. Automatic determination of peak-peak voltages and rise and fall times is possible. In digital mode the waveform is stored in binary code, and can therefore be processed like computer data. Frequency, Vrms, period, rise time, overshoot and pulse width can all be ascertained simply. Filtering of stored waveforms can reveal hidden signals, and Fast Fourier Transforms (FFT) yield the frequency components of a signal. This is shown in Figure 10, a FFT as seen in digital mode, with results in both Hertz and decibels

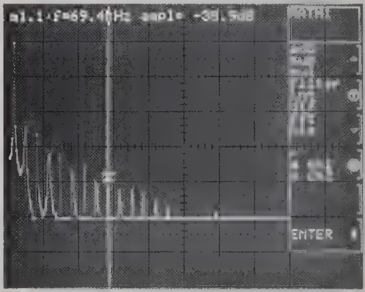


Fig. 10. A Fast Fourier Transform shown using digital mode in Hertz and decibels.

Any stored data can be transferred to a PC for further analysis or storage. It can also be sent to a printer or plotter, and the hard copy also shows the graticule and any on-screen measurement results.

With the mathplus option digital storage oscilloscopes can carry out automatic pass/fail testing. The trace to be tested can be compared either with a user-specified reference template, or against pre-defined measurement limits. When a fail situation occurs, the digital storage oscilloscopes is capable of taking several pre-selected actions. A hard copy can be generated for analysis, the trace can be stored in memory for future reference, an alarm can be activated, or the process can be stopped. This is illustrated in Figure 11.

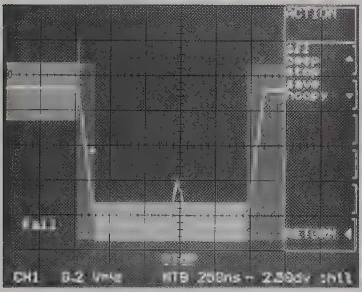


Fig. 11. Signal with reference template and pre-selected options for action in fail situations.

Figure 12 shows how reference templates can be created on screen using cursor controls. Frequently used templates can be stored in non-volatile reference memory, and are thus protected against erasure due to supply failure. Templates can also be downloaded from a computer via RS-232 or the optional IEEE-488.2 interfaces.

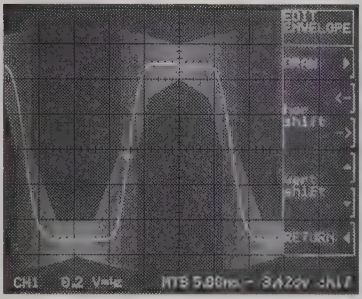


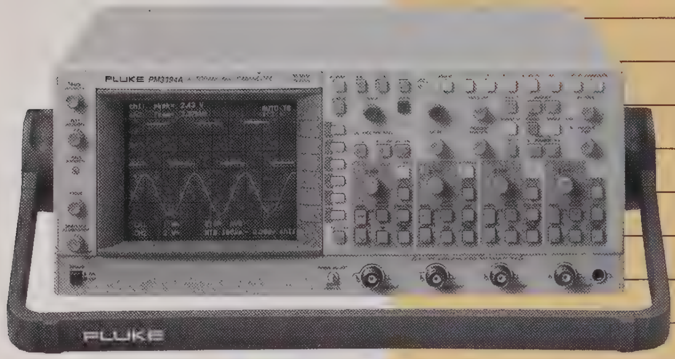
Fig. 12. Creating reference templates using cursor controls.

## Best of Both Worlds

It can be concluded that for every day use, engineers require both analog and digital storage oscilloscopes for optimum viewing and analysis of signals. Although both systems have their relative merits, neither is all-encompassing enough to be used in isolation. Modern CombiScopes™ give the best of both worlds in one instrument.

# CombiScopes

## PM 3370A 60 MHz CombiScope; PM 3380A/82A/84A 100 MHz CombiScopes; PM 3390A/92A/94A 200 MHz CombiScopes


PM 3394A

New Feature

Combined digital storage and analog oscilloscope performance in one instrument

Autoranging for hands-free operation

Up to 200 MS/s sample rate

60 MHz, 100 MHz or 200 MHz analog and digital bandwidths

True 4 channel operation

Continuously variable timebase in digital and analog mode

Up to 32K acquisition memory

Storage of more than 200 traces

Extensive TV and logic triggering

Real time Digital Signal Processing (DSP)

Extensive mathematical functions

RS-232 interface standard

GPIB/IEEE-488.2 (SCPI) interface capability

### CombiScope: The Best of Both Worlds

The oscilloscopes described here are CombiScopes™. This means each instrument combines a high performance Digital Storage Oscilloscope (DSO) with a fully featured analog oscilloscope. At the touch of a button, the operation changes from analog display to Digital Storage Oscilloscope operation and back. Better said: these are DSOs with an analog button. Why?

Because some users can't rely solely on the capabilities of a pure DSO. Furthermore, some signals do not take kindly to being digitized. Examples include simple AM signals, complex data streams and video signals. If you don't see what you expect, or don't trust what you see, just touch the button to switch operating mode. For a full discussion on the topic of "Analog, Digital, or Both?", see the introduction in the oscilloscope section of this catalog.

### Autoranging

These CombiScopes now give you Autoranging to make them really the easiest scopes to operate. Forget about manual set-up; every time you probe another test point, Autoranging, once selected, will automatically scale vertical and horizontal settings to get the signals displayed correctly without you having to touch a single button! You can concentrate on the system under test, and watch how your scope works for you! With every new test point, automatically the scope re-adjusts to show the signal optimally. Thanks to Autoranging.

### Probe Mounted Command Switch

To enhance ease of operation even further, the instruments are delivered with probes that have an exceptional feature: a probe mounted command switch. While probing a system, the command switch can be pressed to initiate a user selectable function: for instance freeze the acquisition on screen, take a quick measurement, switch over to analog mode or back, or select the next setting from an array of pre-defined instrument settings. All without having to reach for the front panel, so that you can concentrate on the task at hand.

### Delayed Time Base

Delayed time base is available in both the analog as well as the digital storage mode of operation. In addition, the digital mode offers pre-trigger recording as well as delay by events. All delay functions can be combined to select that one special event from even the most complex signals.

### Up to 4 Channels – Up to 200 MHz

This family of CombiScopes consists of seven models, to give you a wide choice of bandwidths, channels and sample rate.

Each of these instruments can be further enhanced by a choice of up to four options:

- **MathPlus:** Offering extensive signal analysis features that include Integration, Differentiation and FFT. This option also includes limit testing on measurement parameters or waveform comparison for ATE applications, as well as multiple single shot recording of up to 200 traces in memory.
- **Extended Memory:** Offering user partitioned acquisition and reference memory to permit storage of up to 32K long records, or over 200 traces of 512 points.
- **IEEE-488/SCPI:** Full control of all of the oscilloscope functions, and full waveform transfers with a SCPI compatible GPIB/IEEE-488* option.
- **Auxiliary Outputs:** giving extended analog scope interfacing for complex measurements. Includes analog TB sweep output, MTB and DTB gate output and an external trigger input.

### Operation of Digital Storage That is as Easy as if it Were Analog

With oscilloscopes this powerful, easy access to all functions is of paramount importance. These CombiScopes have been designed with the controls and layout so that the most frequently used functions have their own control or button giving instant direct access. Layout is logical, and all functions that work in the Analog mode work in the same way in the Digital mode. A dedicated processor continuously scans the controls and buttons, so that the operation of these models is as fast as if they were fully analog. Additional functions are in logical and easy to understand, "shallow" menus.

### Triggering to Deal With the Impossible

Trigger features include full triggering for either time base, in either operating mode. In the digital mode, logic state and logic pattern triggering allow you to set qualified trigger conditions using all of the four

GPIB
IEEE-488

RS-232

## PM 3370A 60 MHz CombiScope; PM 3380A/82A/84A 100 MHz CombiScopes; PM 3390A/92A/94A 200 MHz CombiScopes

input channels (not on PM 33x0A). Glitch triggering allows for time qualified trigger conditions starting from 10 ms to a fast 20 ns, where triggering occurs in response to the duration of an event.

### Choice of Memory

These CombiScopes come with 8K of waveform memory. The memory extension option provides you with up to 32K. Memory is easily partitioned by the user giving the optimum between record length, number of traces stored, and update speed (shorter records provide faster update rates). With standard memory, the choice can be from one 8K record to 36 records of 512 points. The Extended Memory option allows for one 32K record, to over 200 records of 512 points each. Regardless of the record length selected, the user can always display the full contents of the memory. In PM 33x0A, each channel is equipped with up to 4K memory as a standard; the memory extension can store records of 16K for each channel, or up to 153 waveforms of 512 samples each.

### Cursors and Measurements

Cursors are available in both Analog and Digital modes. In the DSO mode, the cursors are supplemented by automatically calculated measurements that include: Vp-p, Vrms, Vmax and Vmin, frequency and period, rise time and overshoot. "Touch-Hold and Measure" gives you instant measurement results. It provides a quick update of Vdc, Vp-p, Vrms and Frequency at the touch of the command button located on the probe.

### Signal Analysis

These CombiScopes offer a very extensive set of signal analysis functions that include Addition, Subtraction, and Multiplication of signals. Digital Filtering permits noise or high frequency components to be removed from signals, including single events. With the MathPlus option installed, waveforms can be Differentiated to find Slew rate, Integrated for Area under the curve, and an FFT is included to find frequency components of any signal. The fast Digital Signal Processor (DSP) presents the results in almost real time.

### Supports Test Engineering and Factory Automation

The MathPlus option includes a variety of features to support factory automation. Measurement results can be updated, with statistical records of the highest and lowest values kept in memory. Measurement data can be used to perform automatic Pass/Fail tests. In addition, Pass/Fail tests can be performed on the actual waveform itself, by comparing it with a template stored in memory. You can create such templates in the scope, or download them from a PC.

### Field Service Support

With heavyweight performance weighing in at approximately 20 pounds, and with their rugged construction, these scopes are built to go. A full analog scope and a full Digital Storage Oscilloscope in one instrument, means you don't have to compromise. And they are easy to use! Supporting software is available, enabling service personnel to upload and download waveforms, instrument settings, and measurements from and to any DOS based PC.

### Hard Copy

These scopes support 9 pin and 24 pin dot-matrix printers. LaserJets (HP PCL 4 and PCL 5) are also supported. Plotter support is also provided for a selection of HP compatible plotters, as well as a generic HPGL driver. The HPGL driver is also useful to provide output to PCs, so that HPGL files can be directly imported in most popular word processing packages to provide professional documentation with ease.

### Digital Three-Processor Architecture for Fast Response

In order to get the highest possible update rate and in order to have a fast response to control changes, these scopes are all equipped with a powerful three-processor architecture, taking care of all hardware control and data management. All digital signal processing tasks are carried out by a dedicated Digital Signal Processor (DSP), ensuring extremely fast update rates for even the most demanding operations like a Fast Fourrier Transform (FFT).

### Built to Last, at Low Cost

Hi tech design eliminating trimmers and pots means no internal adjustments. Calibration is performed "closed case". Calibration is METCAL supported and completed in less then one hour. With all of the controls being µP operated, and all of the switching being done in sealed environments, controls are impervious to dust, moisture, or wear. And with a calculated MTBF of over 15,000 hours, a three year warranty, and a five year warranty on the CRT, these scopes will perform reliably and at low cost to the owner for many years to come.

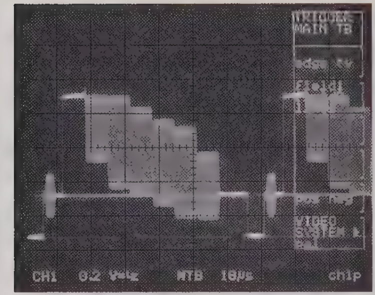
| | PM 3370A | PM 3380A | PM 3382A | PM 3384A | PM 3390A | PM 3392A | PM 3394A |
|---|---|---|---|---|---|---|---|
| Bandwidth | 60 MHz | 100 MHz | | | 200 MHz | | |
| Number of channels | 2 + External Trigger View | | 2+2 | 4 | 2 + External Trigger View | 2+2 | 4 |
| Max. Sample Rate (single shot) | 100 MS/s | | 200 MS/s | | 100 MS/s | 200 MS/s | |
| Max. Equivalent Sample Rate | 10 GS/s | | | | 25 GS/s | | |
| Risetime | 5.8 ns | 3.5 ns | | | 1.75 ns | | |
| Max. Acquisition Memory, standard memory (with Extended Memory) | 4K (16K) | | 8K (32K) | | 4K (16K) | 8K (32K) | |
| Max. number of traces stored, standard memory (incl. Extended Memory) | 30 (156) | | 40 (208) | | 30 (156) | 40 (208) | |
| Autoranging | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| RS-232 interface | standard | standard | standard | standard | standard | standard | standard |
| IEEE-488/GPIB | optional | optional | optional | optional | optional | optional | optional |

Table 1

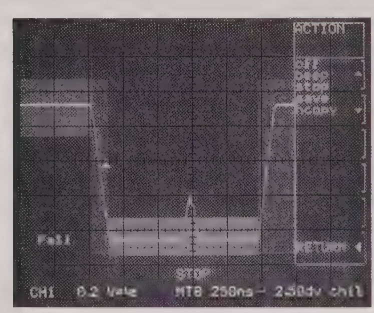
FLUKE

# CombiScopes

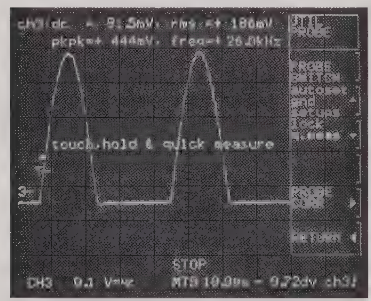
## PM 3370A 60 MHz CombiScope;
## PM 3380A/82A/84A 100 MHz CombiScopes;
## PM 3390A/92A/94A 200 MHz CombiScopes


TRIGGER MAIN TB
VIDEO SYSTEM
CH1 0.2 V≈ MTB 10µs chlp

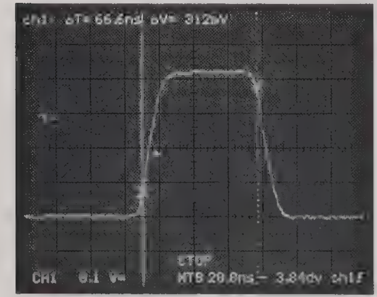
Monitoring video signals and other modulated or complex signals requires the infinite resolution and intensity variation only available from a true analog scope.


ACTION
Fail
RETURN
STOP
CH1 0.2 V≈ MTB 250ns

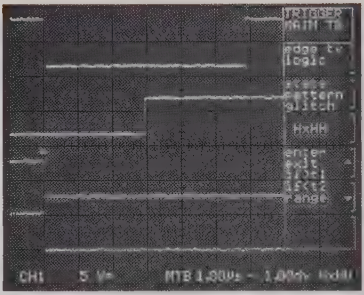
Pass/fail function showing a glitch that violates the reference envelope or template, causing a fail event (Math + Option).


touch hold & quick measure
STOP
CH3 0.1 V≈ MTB 10.0ns

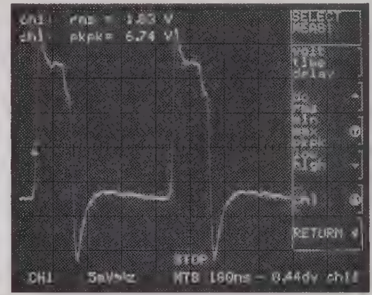
The probe-operated Touch Hold and Measure™ feature freezes the trace on-screen, and displays measured results.


STOP
CH1 0.1 V= MTB 20.0ns

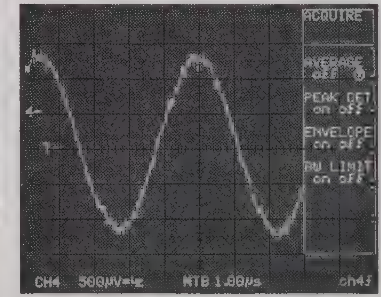
The pre-trigger capability of a DSO shows what leads up to an event, as well as the leading edge of signals – even if they only occur once.


TRIGGER MAIN TB
edge tv logic
pattern glitch
range
CH1 5 V= MTB 1.00µs

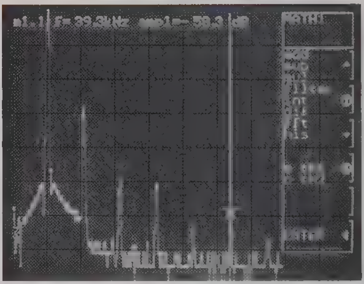
Pattern triggering is useful in microprocessor and logic applications, and in mixed analog/digital circuits (only in 2 + 2 and 4 channel models).


ch1 rms = 1.83 V
ch1 pkpk= 6.74 V
SELECT MEAS
RETURN
STOP
CH1 5mV≈ MTB 100ns

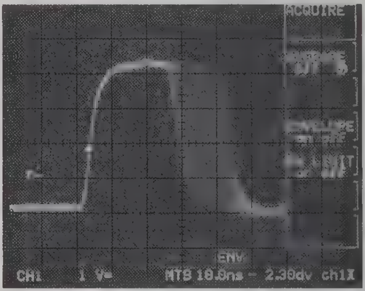
These CombiScopes feature an extensive set of built-in calculated voltage and timing measurement functions. Instant results can be obtained two ways: By simply selecting the desired measurement function and the channel on the front panel. Or using the probe-mounted Touch Hold and Measure button.


ACQUIRE
AVERAGE off
PEAK DET on off
ENVELOPE on off
BW LIMIT on off
CH4 500µV≈ MTB 1.00µs ch4

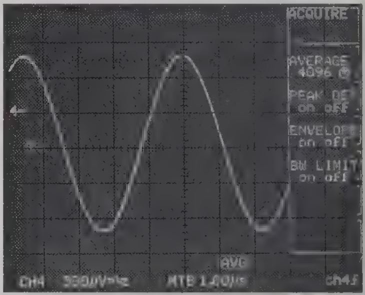
To suppress noise on repetitive signals the averaging mode smooths the representation of the trace. For non-repetitive signals, digital filtering is provided to suppress noise.



The Math+ option provides advanced waveform processing, such as integration, differentiation and FFT. It also has automatic cursor positioning, envelope generation and you can automate your pass/fail testing in ATE applications.


ACQUIRE
ENVELOPE on off
BW LIMIT off
ENV
CH1 1 V= MTB 10.0ns

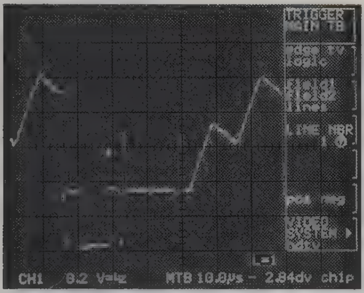
The envelope mode monitors signal variations over time. You can measure interference signals, jitter, amplitude modulated signals and more.


ACQUIRE
AVERAGE 4096
PEAK DET on off
ENVELOPE on off
BW LIMIT on off
AVG
CH4 500µV≈ MTB 1.00µs ch4

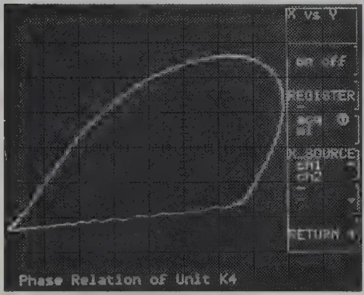
Both averaging and low-pass filtering improves vertical resolution. Results are stored in 16-bit memory.

# CombiScopes

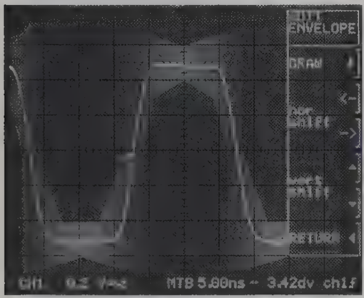
## PM 3370A 60 MHz CombiScope; PM 3380A/82A/84A 100 MHz CombiScopes; PM 3390A/92A/94A 200 MHz CombiScopes



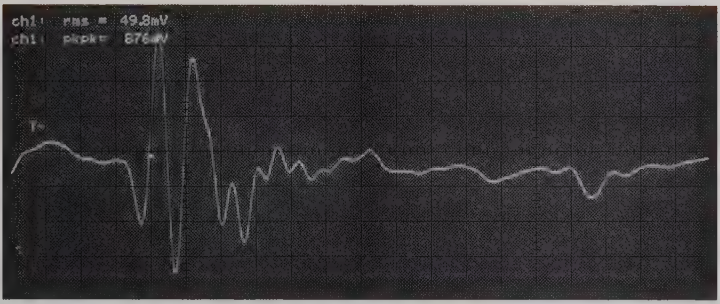
For high resolution video application HDTV tri-level-sync triggering is included. The scopes also include a digital line selector. Delay and magnification or a fully triggered delayed time base can be used to expand any part of a selected line or any other part of a signal.



The X versus Y mode lets you display any of the four channels against another. This XY mode is extremely useful for modulation, voltage/current curves, and mechanical signals phase displays.



With the Math + option, reference templates for pass/fail testing can be created in seconds on screen simply by using cursor controls. That way, you can create your own reference envelope, for example, by recreating a CCITT reference template for PCM testing. Frequently used reference templates can be stored in the reference memories and protected. Templates can also be downloaded from an external computer using Anywave 2.0 software (PM 2273)



Also, in the Math + option is a multiple single shot mode. This feature allows you to capture consecutive single shot events and store them into memory, 32 traces with standard memory and 200 traces with the Expanded Memory Option.

## Specifications

### Technical Specifications

### CombiScopes

**Analog and Digital:** These CombiScopes are analog/digital combination scopes with screen readout, cursors and a fully triggered delayed timebase. At the touch of a button one can switch between the familiar analog mode with a real time signal display and the digital mode. In the digital mode all typical DSO benefits apply: trace storage, pre-trigger view, calculated measurements, hardcopy facilities, advanced trigger modes, averaging and FFT. The probe operated Touch Hold and Measure™ freezes the display and instantly displays measured signal parameters : Vdc, Vrms, Vp-p and frequency.

**Autoranging:** Automatically and continuously adapts the instruments' horizontal and vertical deflection settings to signals applied. Allows for hands-free operation when a system is probed or when signal amplitude is changing, for instance during adjustment of the system under test.

**Display:** 8 × 10 cm viewing area, 16.5 kV acceleration voltage. Parallax free graticule with continuously variable illumination. On screen settings readout.

**Autoset:** Selects proper channel-, timebase- and trigger settings. Function can be customized by the user to leave specified functions unchanged.

**Autocal:** Automatic fine adjustment for enhanced accuracy to get optimum performance even under extreme environmental conditions.

**Automatic Testing:** The additional pass/fail testing offered by the MATH+ option in combination with the GPIB/IEEE-488.2 interface make these scopes a powerful fully programmable tool in automatic test applications.

**Memory:** The record length is optionally expandable to 32K samples and over 200 traces in memory (at 512 samples/trace).

### Analog Mode

**Input Channels:** Four channels, or two full channels and two channels optimized for logic levels, or 2 channels plus external trigger view (see table 2). On screen channel identifiers with ground level indication on all inputs.

**Display Modes:** CH1, +/-CH2, CH3, +/-CH4 (see table 1 & 2); Add, Subtract; Alternate or Chopped

**Error Limit:** 1.3% (measured over center 6 divisions)

**Input Impedance:** 1 MΩ ±1% // 25 pF ±2 pF and/or 50Ω ±1% (see table 2).

**Maximum Rated Input Voltage:** In 1 MΩ position: 400V (dc + ac peak; <10 kHz). In 50Ω position: 5V rms; 50V ac-peak (maximum of 50 mJ during any 100 ms interval).

**Dynamic Range:** 24 div at 50 MHz

**CMRR:** 100:1 at 1 MHz, 25:1 at 50 MHz

**Channel Isolation:** 50:1 at full bandwidth (60, 100 or 200 MHz)

# PM 3370A 60 MHz CombiScope; PM 3380A/82A/84A 100 MHz CombiScopes; PM 3390A/92A/94A 200 MHz CombiScopes

## Vertical Deflection

| | PM 3370A | PM 3380A | PM 3382A | PM 3384A | PM 3390A | PM 3392A | PM 3394A |
|---|---|---|---|---|---|---|---|
| Analog Bandwidth (-3 dB) | 60 MHz | 100 MHz | | | 200 MHz | | |
| Risetime (calculated from the Bandwidth) | 5.8 ns | 3.5 ns | | | 1.75 ns | | |
| Number of channels | 2 | | 2+2 | 4 | 2 | 2+2 | 4 |
| Attenuator control channels 1+2 | 2 mV/div .... 5 V/div (in a 1, 2, 5 sequence)<br>2 mV/div .... 12.5 V/div calibrated continuously variable | | | | | | |
| Attenuator control channels 3+4 | N.A. | | 0.1 or 0.5 V/div | as channel 1 and 2 | N.A. | 0.1 or 0.5 V/div | as channel 1 and 2 |
| Bandwidth Limiter | -3 dB @ ≥ 20 MHz | | | | | | |
| Input impedance channels 1 and 2 | 1 MΩ | | | | 1 MΩ and 50Ω | | |
| Input impedance channels 3 and 4 | N.A. | | 1 MΩ | | N.A. | 1 MΩ | 1 MΩ and 50Ω |

Table 2

## Horizontal (Main and Delayed Time Base)

**Display Modes:** Main time base, Delayed time base, Alternate time base (Main and Delayed time base), X-Y mode.
**Time Coefficients:** 0.5 s/div to 20 ns/div in a 1-2-5 sequence or calibrated variable control giving 1.25 s/div to 20 ns/div. For PM 338xA and PM 3370A the fastest time base setting is 50 ns/div.
**Fastest Sweep (magn x10):** 2 ns/div; 5 ns/div for PM 338xA/PM 3370A
**Error Limit (magn x1):** ±(1.3% of reading + 0.5% of 8 divisions)

## Delay Time Multiplier

**Resolution:** 1:40,000
**Error Limit (magn x1):** ±(0.8% of reading + 0.3% of 8 divisions + 4 ns)
**Jitter:** 1:25,000

## Triggering (Main and Delayed Time Base)

**Trigger Modes:** Auto free run, Triggered, Single; Edge triggering, TV triggering.

## Edge Triggering

**Main TB Trigger Source:**
**PM 33x4A & PM 33x2A:** any input channel or Line (= mains); Optional rear mounted External Trigger input replacing Line triggering.
**PM 33x0A:** CH1, CH2, External.
**Delayed TB Trigger Source:** Starts after delay or triggered on any input channel
**Slope:** Positive or negative
**Coupling:** DC, AC (>10 Hz), LF-rej (30 kHz), HF-rej (30 kHz).

**Trigger Gap:** 0.4 div; or 0.8 div for triggering on noisy signals
**Level Range:** ±8 div or automatic level within signal peak-peak range
**Level Indication:** On screen level indicators and numeric readout

| Trigger Sensitivity | PM 339xA | PM 338xA | PM 3370A |
|---|---|---|---|
| 30 MHz | – | – | 0.6 div |
| 50 MHz | – | 0.6 div | – |
| 60 MHz | – | – | 1.2 div |
| 100 MHz | 0.6 div | 1.2 div | – |
| 150 MHz | – | – | 2.0 div |
| 200 MHz | 1.2 div | 2.0 div | – |
| 300 MHz | 2.0 div | – | – |

## Video Triggering

**Video Standard:**
NTSC, PAL, SECAM, HDTV
**Main TB Trigger Source:** any input channel; lines or any specific line from the video frame using built-in line counter.
**Delayed TB Trigger Source:** Starts after delay or triggered on any input channel edge, TV-line; the Delayed time base can be used to expand any part of the line selected with the TV-line selector.
**Signal Polarity:** Positive or negative
**Sensitivity:** 0.7 div (sync. pulse)

## X-Y Mode

**X-deflection Source:** Any input channel or Line
**X-deflection Coefficient:** Same as for vertical deflection
**Dynamic Range:** 20 div up to 100 kHz; >10 div up to 2 MHz
**Frequency Response:** -3 dB at ≥2 MHz
**Error Limit:** 5% measured over central 6 divisions
**Phase Shift:** <3° up to 100 kHz

## Cursor Measurements

**Cursor Modes:** Horizontal, Vertical, Both
**Readout:** Vertical: dV, V1 to gnd, V2 to gnd, Ratio
**Horizontal:** dT, 1/dT (in Hz), Ratio, Phase
**Accuracy:** (magn x1) 1% of full scale within the central 8 horizontal and 6 vertical divisions.

| | PM 3370A | PM 3380A | PM 3382A | PM 3384A | PM 3390A | PM 3392A | PM 3394A |
|---|---|---|---|---|---|---|---|
| Bandwidth (-3 dB) | 60 MHz | 100 MHz | | | 200 MHz | | |
| Risetime (calculated from the Bandwidth) | < 5.8 ns | < 3.5 ns | | | < 1.75 ns | | |
| Maximum Sample Rate (single shot) | 100 MS/s | | 200 MS/s | | 100 MS/s | 200 MS/s | |
| Calculated Max. Captured Frequency (single shot) using 5 samples per cycle and sine interpolation: | 20 MHz | | 40 MHz | | 20 MHz | 40 MHz | |
| Max. Equivalent Sample Rate | 10 GS/s | | | | 25 GS/s | | |
| Max. Captured frequency, repetitive signals | >60 MHz | >100 MHz | | | >200 MHz | | |
| Max. Acquisition Length (standard memory) | 2CH x 4K | | 1CH x 8K | | 2CH x 4K | 1CH x 8K | |
| Max. Acquisition Length (expanded memory) | 2CH x 16K | | 1CH x 32K | | 2CH x 16K | 1CH x 32K | |
| Number of Autoranging input channels | 2 | 2 | 2 | 4 | 2 | 2 | 4 |
| Autoranging Timebase | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Logic triggering | glitch | | state, pattern, glitch | | glitch | state, pattern, glitch | |

Table 3

# PM 3370A 60 MHz CombiScope; PM 3380A/82A/84A 100 MHz CombiScopes; PM 3390A/92A/94A 200 MHz CombiScopes

## Digital Mode

### Acquisition

**Sample Rate:** Real time sampling up to: 200 MS/s (single channel), 100 MS/s (dual channel). A fast chopper offers 200 ns horizontal resolution in 4 channel single shot mode.

PM 33x0A: 100 MS/s on the two input channels simultaneously (see also table 3)

**Random Sampling:** Random sampling for repetitive signal display of all channels up to the full bandwidth (see table 3)

Acquisition Length and Trace Storage: See table 4.

| PM 3382A, PM 3384A, PM 3392A, PM 3394A | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | Standard Memory | | | | With Extended Memory Option Installed | | | |
| Acquisition Length | 1CH x 8K | 2CH x 4K | 4CH x 2K | 4CH x 512 | 1CH x 32K | 2CH x 16K | 4CH x 8K | 4CH x 512 |
| Trace storage | 3 traces | 6 traces | 12 traces | 40 traces | 3 traces | 6 traces | 12 traces | 208 traces |

| PM 3370A, PM 3380A, PM 3390A | | | | | | |
|---|---|---|---|---|---|---|
| | Standard Memory | | | With Extended Memory Option Installed | | |
| Acquisition Length | 2CH x 4K | 2CH x 2K | 2CH + Trig. View x 512 | 2CH x 16K | 2CH + Trig. View x 8K | 2CH + Trig. View x 512 |
| Trace storage | 6 traces | 9 traces | 30 traces | 6 traces | 9 traces | 156 traces |

Table 4

**Maximum Captured Frequency: Calculated maximum captured frequency in single shot mode (see table 3):**

- Using sine interpolation to reconstruct signals from 5 samples per period: up to 40 MHz in 1 CH mode, 20 MHz in 2 CH mode, 1 MHz in 4 CH mode.
- For 10 samples per period, using linear interpolated: up to 20 MHz in 1 CH mode; 10 MHz in 2 CH mode, 0.5 MHz in 4 CH mode

**Bandwidth Limiter:** -3 dB @ ≥20 MHz

**Vertical Resolution:** ADC resolution 8 bit, memory resolution 16 bit.

**Memory:** acquisition and reference memory can be segmented offering a choice between long acquisition records or a high update speed and a maximum number of traces in memory. (See table 4)

**Average:** Factor: 2,4,8 to 4096; giving resolution up to 14 bit

**Peak Detection:** Captures glitches up to 5 ns (single channel, not in PM33x0A), 10 ns (dual channel) or 10 ns (4 channel alternating)

**Envelope Mode:** For continuous tracking of changing waveforms

### Vertical

**Auto-ranging vertical deflection** Automatically and continuously adapts vertical deflection setting to have 2....6 divisions display of input signal. Can be selected individually on any fully controllable input channel. Minimum deflection setting automatically selected is 50 mV/div.

**Bandwidth:** 60 MHz, 100 MHz or 200 MHz (see table 3)

**Magnification:** Up to x32 magnification for higher deflection sensitivity; can be used with averaging (up to 4096x) for maximum resolution (up to 14 bit)

**Display Modes:** CH1, +/-CH2, CH3, +/-CH4, Calculated Add and Subtract (see table 2)

**Bandwidth Limiter:** -3 dB at ≥20 MHz

**Window Mode:** 2 or 4 windows to display two or four traces above each other while using the full dynamic range of the ADC

### Horizontal

**Autoranging timebase** Continuously adapts sweep speed to the frequency of the trigger signal in order to keep 2....6 cycles on screen; user selectable function. Autoranging timebase can work with timebase in 1-2-5 sequence or with continuously variable timebase mode, freezing the number of cycles on screen.

**Acquisition Modes:** Recurrent (Auto and Triggered), Single shot, Multiple single shot (part of MATH+ option), Roll, Triggered Roll

**X-Y Mode:** Any trace in memory or any of the input channels can be used as X source

**Time Base Modes:** Main TB, Delayed TB, Alternate TB (Main TB and Delayed TB). Delayed time base starts after delay or triggered on channel. User selectable Autoranging timebase.

**Time Base:** Real time sampling (magn x1): 200 s/div to 500 ns/div in a 1-2-5 sequence; PM 33x4A and PM 33x2A also give 250 ns/div

**Variable timebase:** Continuously variable sweep speed: 1 µs/div .... 500 µs/div in 1 µs increments; 500 µs/div .... 200 s/div with 0.2% or smaller increments.

**Recurrent:** 200 ns/div to 2 ns/div (5 ns/div for PM 338xA and PM 3370A) in 1-2-5 sequence.

**Roll Mode:** 200 s/div to 200 ms/div, triggered or free roll mode, in 1-2-5 sequence or continuously variable.

**Display Resolution:** Horizontal resolution for 1x magnification: 500 samples = 10 divisions = 1 screen width.

**Magnification:** x2, x4 to x32 to zoom in on parts of waveform, compression to allows a compact full information display of a full record (8K or 32K).

**Interpolation:** Dots only display or Sine or Linear interpolated display; sine interpolation offers natural signal representation of expanded single shot acquisitions up to 10 ns/div

### Triggering

**Trigger Coupling:** Same as for analog mode.

**Edge Triggering:** Same as for analog mode, Dual Slope Triggering available when in single shot, real time sampling mode

**TV Triggering:** Same as for analog mode (including digital TV-line selector)

**Logic Trigger Modes:** State (4 bit), Pattern (4 bit), Glitch (time qualified pulse). See table 3 for availability per model number. Channels can be 'high', 'low', or 'don't care'.

**Sensitivity:** 1 div if time present ≥10 ns (20 ns for PM 338xA, 30 ns for PM 3370A), 2 div if time present ≥2 ns (4 ns for PM 338xA, 6 ns for PM 3370A)

**State Triggering:** Max. clock rate: 150 MHz. Any of the channels can be selected as clock, triggering occurs if combination of all other channels matches description at moment of clock edge.

**Pattern Triggering:** Mode: Enter, Exit, Time qualified (lower limit, upper limit, range)

**Range of Limits for Pattern Triggering:** 20 ns to 166 ms; resolution: 10 ns; minimum time for pattern to be present is 2 ns (4 ns for PM 338xA)

**Glitch Triggering:** Minimum glitch width: 2 ns (4 ns for PM 338xA, 6 ns for PM 3370A). Pulse width time qualification: lower limit, upper limit, range.

**Range of Limits for Glitch Triggering:** 20 ns to 166 ms; resolution 10 ns.

### Delay

**Time Delay:** 0 to 1,000 div. continuously adjustable.

**Pre-Trigger View:** Up to a complete record can be filled with pre-trigger information (160 div for an 8K record,

# PM 3370A 60 MHz CombiScope; PM 3380A/82A/84A 100 MHz CombiScopes; PM 3390A/92A/94A 200 MHz CombiScopes

640 divisions for optional 32K memory installed)
**Event Delay:** 1 to 16,384 events; maximum count rate: 50 MHz (typical); source: any channel; modes: Event delay, Time delay after event delay
**Delay Modes:** Start after time delay or wait for trigger after time delay

### Cursor Measurements

**Cursor Modes:** Horizontal, Vertical, Both; Free or locked to trace
**Readout Vertical:** dV, V1 to gnd, V2 to gnd, Ratio
**Horizontal:** dT, 1/dT (in Hz), Ratio, Phase (cycle is automatically referenced to trigger signal)

### Calculated Measurements

Measurements can be performed over a full record or within a cursor limited area.
**Volt:** DC, rms, minimum, maximum, peak to peak, Low level, High level, Overshoot (positive and negative), Preshoot (positive and negative)
**Time:** Frequency, Period, Pulsewidth, Rise time, Fall time, Duty cycle
**Delay:** Channel to channel; rising and falling edges
**Quick Measurement:** Probe operated "Touch & Hold" instantly gives calculated measurement of: frequency, dc, rms and Vp-p

### Processing

**Standard:** Add, Subtract, Multiply, Digital filter (For low pass filtering after single shot capture)
**MATH+ Option:** Integrate, Differentiate, FFT, Histogram

## General Specifications

### Interfacing

**RS-232C Serial Interface:** Installed as standard. Enables printing and plotting as well as full remote control of the instrument. Also provides fast trace dump to PC or Fluke arbitrary waveform generator. DB-9 male connector.
**Baudrate:** 75 to 19200 (full duplex), 38400 dump only.
**Handshake:** DSR/DTR, CTS/RTS and Xon/Xoff.
**Format:** 1 Stopbit; 7 or 8 databits; odd/even/no parity.
**Protocol:** CPL = Compact Programming Language = reduced set of powerful instructions for remote control through RS-232C
**GPIB/IEEE-488.2 Interface:** Factory installed option. Remote control conforming to SCPI (Standard Commands for Programmable Instruments).
**Waveform Dump:** Fast trace dump to PM 5150, PM 5138 and PM 5139 arbitrary waveform generators using either IEEE or RS-232 interfaces.

### Hardcopy

**Output:** Printed or plotted hardcopy of the screen (digital mode) in scalable format and, if selected, with a status report of the complete instrument settings and with real-time clock data on acquired waveform and hardcopy timestamp.
**User Text:** Two lines of on screen text for documentation.
**Interface:** RS-232C included; GPIB/IEEE-488.2 optional.
**Printer Drivers:** FX Series (9-pins), LQ1500 (24 pins), HP 2225 (ThinkJet), HP LaserJet (series II and III) and compatibles
**Plotters:** HP 7440, HP 7550, HP 7475A, HP 7470A and compatibles, HPGL
**Camera:** Camera kit PM 9381/001 available as optional accessory

### Miscellaneous

**Setting Memory:** 10 complete instrument setups, with battery back-up. Settings can be recalled from front panel or under control of probe mounted command switch
**Calibration Output:** 600 mV peak-peak (±1%), 2 kHz square (±20%)
**Z-Modulation Input:** BNC, 10 kΩ, >2.4V= blanked, <0.5V= unblanked. (analog mode only)
**Time Between Calibration:** 2,000 hrs or 1 year with specified accuracy; 4,000 hrs or 2 years if error limits are doubled
**Probe:** Automatic detection of indication ring or manual selectable scale factor. Manual selection of non-standard scale factors and units of measure are part of MATH + package

### Power Supply

**Line Voltage:** 100V to 240V ±10% in one range
**Line Frequency:** 50 Hz to 400 Hz ±10%
**Power Consumption:** 115W; 130W with all options installed

### Mechanical Data

**Fan:** Proportionally regulated forced air
**Dimensions:**
**Width:** 391 mm (15.4 in) incl. handle; 341 mm (13.4 in) excl. handle
**Length:** 551 mm (21.7 in) incl. handle; 481 mm (18.9 in) excl. handle
**Height:** 147 mm (5.8 in) incl. feet; 139 mm (5.5 in) excl. feet
**Weight:** 9.5kg (21 lb)

### Environmental Data

**Meets:** Requirements of MIL-T-28800D Type III, Class 3, Style D, Color R, as specified below
**Temperature:** 0°C to +50°C (operating), 5°C to +40°C (use), −40°C to +70°C (storage)
**Humidity:** ≤95% (storage)
**Altitude:** Max. 4.6 km = 15,000 ft (operating), 12 km = 40,000 ft (transport)
**Vibration:** Frequency 5 Hz to 55 Hz, Maximum Acceleration at 55 Hz 30 m/s$^2$
**Shock:** 6 shocks along each axis, half sine wave, 6 to 9 msec, peak acceleration 400 m/s$^2$
**Bench Handling:** Meets MIL-STD-810, method 516, procedure V
**Safety:** Meets requirements of: IEC 348 Class I, UL 1244, VDE 0411, CSA C22.2 No 231 approved
**EMI:** VDE 0871 Grenzwertklasse B; MIL-STD-461C: CE01 Part 2 (narrow band), CE03 Part 4, CS01 Part 2, CS06 Part 5 (300V max.), RE01 Part 5 and 6, RE02 Part 2 (1GHz max.)
**Magnetic Susceptibility:** Deflection for extreme conditions: <0.7 div/mT for 1.42 mT peak-peak, 45 Hz to 66 Hz
**CE:** Compliant as of January 1996

## Options

### Expanded Memory Option

Allows acquisition and storage of traces of up to 32K samples or storage of over 200 traces of 512 samples each. See table 4 for details per typenumber.

### MATH+ Option

**Additional Processing:** Integrate, Differentiate, FFT, Histogram
**FFT:** High update rate due to dedicated Digital Signal Processor.
User selectable Hamming, Hanning or rectangular window. Relative or absolute signal level read-out in mV$_{rms}$, dBm or dBμV.
**Pass/Fail Testing:** Test waveforms against reference envelope; Test calculated measurement against preset limits; Test cursor measurement against preset limits
**Action On Violation:** User selectable: Beep, Lock, Save acquisition, Print, Plot, send plot to PC with FlukeView software running
**Envelope Creation Internal:** Draw on screen using cursor controls
**Envelope Creation External:** Download from PC
**Advanced Cursors:** Amplitude qualified cursors for timing measurements with time cursors automatically positioned relative to the signal's Max peak, Min peak, High level, Low level, or to absolute levels
**Multiple Single Shot:** For capturing and storing of consecutive single shot acquisitions in all non-protected, memory locations (up to 200)
**Probe correction:** can be used to get correct read-out when non-standard probes are used, or to work with units of measure other than volts.

### GPIB/IEEE-488.2 Option

**Protocol:** SCPI = Standard Commands for Programmable Instruments = Standardized protocol. Fully compatible with IEEE-488.2.

# PM 3370A 60 MHz CombiScope; PM 3380A/82A/84A 100 MHz CombiScopes; PM 3390A/92A/94A 200 MHz CombiScopes

### Auxiliary Output/External Trigger Option

**Factory Installed Option Includes:**
**Y-Out:** BNC, 50Ω, 10 mV/div into 50Ω, 20 mV/div into 1 MΩ
**MTB-Gate-Out:** BNC, 1 kΩ, TTL compatible levels
**DTB-Gate-Out:** BNC, 1 kΩ, TTL compatible levels
**External Trigger Input with the Following Characteristics (not on 33x0A)**
**MTB Trigger Source:** CH1 to CH4, external (no line triggering)
**Impedance:** 1 MΩ
**Coupling:** AC, DC, LF-rej (30 kHz), HF-rej (30 kHz)
**Slope:** Positive (+) or negative (–)
**Trigger Gap:** 80 mV; trigger gap can be doubled for triggering on noisy signals
**Bandwidth:** Sensitivity at 10 MHz: 200 mV
**Input Amplifier:** Dynamic range of the DC coupled input amplifier:
-2.5V to +2.5V (on BNC connector);
-25V to +25V (on probe tip of 10:1 probe)
**Maximum Input Voltage:** 400V peak

## Ordering Information

### Models

**PM 3370A** 60 MHz CombiScope with 2 channels and Delayed Time Base *$3370*
**PM 3380A** 100 MHz CombiScope with 2 channels and Delayed Time Base *$3575*
**PM 3382A** 100 MHz CombiScope with 2 + 2 channels and Delayed Time Base *$5310*
**PM 3384A** 100 MHz Full 4 Channel CombiScope with Delayed Time Base *$5850*
**PM 3390A** 200 MHz CombiScope with 2 channels and Delayed Time Base *$4790*
**PM 3392A** 200 MHz CombiScope with 2 + 2 Channels and Delayed Time Base *$6390*
**PM 3394A** 200 MHz Full 4 Channel CombiScope with Delayed Time Base *$6925*

### Included with Instrument

Three-year product warranty, parts and labor, five-year CRT warranty; two 100 MHz 10:1 probes, model PM 9010/091, with 1.5m (5 ft) cable and scale factor readout (PM 338xA/PM 3370A); or two wide bandwidth 10:1 probes, model PM 9020/091, with 1.5m (5 ft) cable and scale factor readout (PM 339xA); blue CRT contrast on CRT; memory back up batteries; protective front cover; operator and reference manual; programming manual (IEEE versions only); a service manual is available upon return of reply card included with each instrument; and Certificate of Calibration Practices. Guide to Mathematical Functions & Pass/Fail testing (Math+ versions only).

### Optional Configurations

When ordering, select basic (PM) model number, and add the configuration option number listed below as a suffix.
**/00n** Standard Version
**/02n** MP (Math+) *$550*
**/06n** EM (Extended Memory) *$560*
**/08n** MP + EM *$1100*
**/40n** IEEE-488 (GPIB/IEEE-488.2 interface with SCPI) *$550*
**/42n** IEEE-488 + MP *$1100*
**/46n** IEEE-488 + EM *$1100*
**/48n** IEEE-488 + MP + EM *$1650*
**/91n** IEEE-488 + AuxOut/ExtTrig *$850*
**/93n** IEEE-488 + MP + AuxOut/ExtTrig *$1400*
**/97n** IEEE-488 + EM + AuxOut/ExtTrig *$1400*
**/99n** IEEE-488 + EM + MP + AuxOut/ExtTrig *$1950*

Options are not retrofittable. All required options must be included when order is placed.

The **n** indicates the required line cord. To select your line cord substitute the **n** by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

### Example, Ordering Configuration

To order a 200 MHz, full four channel Digital Storage Oscilloscope with Extended Memory and Math+, plus GPIB/IEEE-488 interface installed, and U.S. line cord select:

| | Model |
|---|---|
| Basic Oscilloscope | PM 3394A |
| MP + EM + GPIB/IEEE-488 | /48x |
| US line cord (n = 3) | /xx3 |
| Complete Model Number | PM 3394A/483 |

### Accessories – Passive Probes

**PM 9011/001** Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 100 MHz (in 10:1 mode), 10 MHz (in 1:1 mode) *$85*
**PM 9021/001** Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 200 MHz (in 10:1 mode), 10 MHz (in 1:1 mode) *$115*
**PM 9001/001** Modular 1:1 Probe, 1.5m (5 ft) Cable *$75*
**PM 9001/091** Modular 1:1 Probe, 1.5m (5 ft) Cable, Range Indicator and Command Button *$95*
**PM 9001/201** Modular 1:1 Probe, 2.5m (8 ft) Cable *$90*
**PM 9001/291** Modular 1:1 Probe, 2.5m (8 ft) Cable, Range Indicator and Command Button *$110*
**PM 9010/001** Modular 100 MHz 10:1 Probe, 1.5m (5 ft) Cable *$80*
**PM 9010/091** Modular 100 MHz 10:1 Probe, 1.5m (5 ft) Cable, Range Indicator and Command Button *$110*
**PM 9010/201** Modular 100 MHz 10:1 Probe, 2.5m (8 ft) Cable *$100*
**PM 9010/291** Modular 100 MHz 10:1 Probe, 2.5m (8 ft) Cable, Range Indicator and Command Button *$120*
**PM 9020/001** Modular 200 MHz 10:1 Probe, 1.5m (5 ft) Cable *$110*
**PM 9020/091** Modular 200 MHz 10:1 Probe, 1.5m (5 ft) Cable, Range Indicator and Command Button *$130*
**PM 9100/001** Modular 200 MHz 100:1 Probe, 1.5m (5 ft) Cable *$155*
**PM 9100/091** Modular 200 MHz 100:1 Probe, 1.5m (5 ft) Cable, Range Indicator *$180*
**PM 8918/301** Low-Pass filter probe, bandwidth 4 kHz *$124*
**PM 9002/001** General accessory set for PM 9000 series probes *$35*
**PM 9102/001** General accessory set for PM 9100 series probes *$40*
**PM 9003/001** Accessory extension set for PM 9000 series probes *$70*

### Accessories – Active Probes

**PM 8940/09n** High Voltage Isolation Amplifier *$1120*
**PM 9355/09n** 70 MHz AC Current Probe *$1350*
**80i-110s** AC/DC Current Probe for Oscilloscopes *$395*

### Other Accessories

**PM 8902A/001** 12V DC Power Inverter *$320*
**PM 8903A/00n** Battery Pack, Charger, Inverter and Carrying Case *$680*
**PM 8914/001** CombiScope Serial Interface Cable *$50*
**PM 8960/041** Retrofittable Rack Mount *$275*
**PM 8989/031** Traveller Carrying Case with Accessory Storage Compartments *$140*
**PM 8991/041** Oscilloscope Cart *$575*
**PM 8992/801** Accessory Pouch *$65*
**PM 2122/021** 50Ω Coaxial Switch *$970*
**PM 9051/001** BNC male to 4 mm Banana Jack/Binding Posts *$27*
**PM 9074/001** 50Ω Coaxial Cable 1m (3 ft) *$27*
**PM 9585/011** 50Ω Feedthrough Termination, 1W *$60*
**PM 9381/001** Oscilloscope Camera System *$875*
**80i-500s** AC current probe for oscilloscopes *$170*
**80i-1000s** AC current probe for oscilloscopes *$395*
**TC100** Instrument Cart *$540*

### Supporting Software

**SW33W** FlukeView™ CombiScope for Windows™ *$295*
**PM 2273** AnyWave *$295*

### Customer Support Services

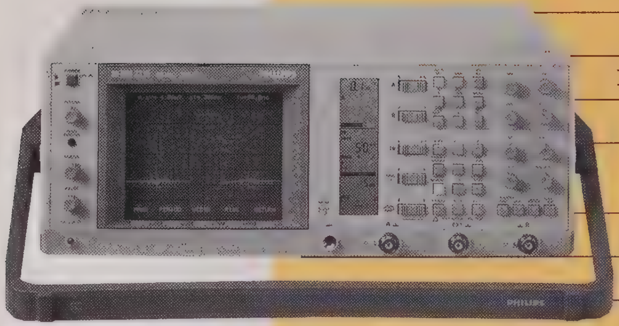
### Factory Warranty

Three-year product warranty. Five-year CRT warranty.

FLUKE.

# CombiScopes

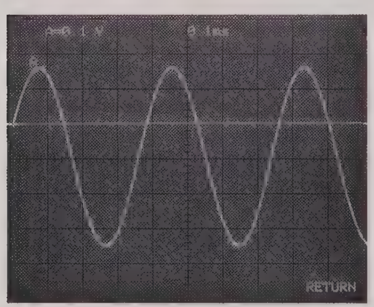
## PM 3350A, PM 3355 60 MHz CombiScopes
## PM 3365A, PM 3375 100 MHz CombiScopes


PM 3375

- Fully featured DSO and Analog oscilloscope
- Choose up to 250 MS/s real time sampling
- Choice of 60 MHz or 100 MHz bandwidth
- Equivalent time sampling for full bandwidth signal capture
- Extensive and stable triggering up to 150 MHz
- AUTOSET for automatic amplitude, time, and trigger setting, works in either mode
- Store up to 8 traces for easy signal comparison
- 16 kV CRT acceleration voltage
- Fast action up/down controls and cold switching
- High reliability: 3 year warranty, 5 year CRT warranty

### Combination of DSO and Analog Modes

These instruments combine the familiarity of analog oscilloscopes with the signal capturing and measurement power of modern Digital Storage Oscilloscopes (DSO). This permits the optimal use of each operating mode to suit every measurement need, and adds confidence to every measurement situation.



Excellent CRT displays ensure crisp and bright displays in the analog mode.

### High 250 MS/s Real Time Sampling

The PM 3375 and PM 3355 offer a real time sampling speed of up to 250 MS/s for high time resolution of any signal, repetitive, or single shot. For less demanding applications, and at lower cost, the PM 3365A and PM 3350A offer up to 100 MS/s real time sampling speed. And in all these instruments, sampling is always simultaneously on both channels.

### Remote Control and Hard Copy Output

GPIB
IEEE-488
RS-232

The optional GPIB/IEEE-488* or RS-232C interfaces permit remote control of these scopes. Programming is straight forward, and an efficient bus learn mode is provided to facilitate application program development. Each interface also includes the ability to provide direct hard copy output to digital plotters and printers.

| | PM 3350A | PM 3355 | PM 3365A | PM 3375 |
|---|---|---|---|---|
| Bandwidth | 60 MHz | 60 MHz | 100 MHz | 100 MHz |
| Sample Rate | 100 MS/s | 250 MS/s | 100 MS/s | 250 MS/s |
| Equivalent Time sampling | no | no | yes | yes |
| Max sensitivity | 2 mV/div | 2 mV/div | 2 mV/div | 2 mV/div |
| Max. Trigger delay | 2500 div | 5000 div | 2500 div | 5000 div |
| Max. Captured Frequency, | | | | |
| • single shot | | | | |
| (for 10 samples/cycle) | 10 MHz | 25 MHz | 10 MHz | 25 MHz |
| • Repetitive | 10 MHz | 100 MHz | 25 MHz | 100 MHz |
| Max. pretrigger view | 10 div | 10 div | 10 div | 10 div |

### High Sensitivity, High Accuracy

These models offer sensitivities as high as 2 mV/div, without using signal expansion, thus maintaining the full 8 bit resolution and associated accuracy. Full range attenuators include 10 V/div settings as well, for excellent signal acquisition versatility at higher amplitudes. All this comes with automatic probe recognition, giving you true signal amplitude screen- and measurement read-outs.

### Digitally Delayed Sweep

In applications where a delayed timebase would be used the built-in digitally delayed sweep capabilities are powerful. Delay is derived from the stable, crystal controlled acquisition clock, where the zoom function provide easier magnification of the waveform part of interest, meanwhile giving a highly accurate delay read-out.

*The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

## Specifications

### Technical Specifications

**AUTOSET:** Autoset selects proper channel or channels, sets vertical deflection, time base speed and triggering for easy-to-read display of input signals

### Analog Mode

Analog mode of the PM 3350A and PM 3355 is identical to the PM 3050, see relevant section.

Analog mode of the PM 3365A and PM 3370 is identical to PM 3065, with a single timebase. See relevant section for details.

### Digital Mode

**Digital Acquisition and Display Modes:** Ch A, Ch B, -Ch B, Ch A and + or - Ch B; both channels sampled simultaneously.

**Processing:** Average (up to 256), Envelope

**Vertical Resolution:** 8 bits

**Horizontal Resolution:** 4096 samples/acquisition (single channel mode at sweep speed 5 ms/div and slower)
2048 samples/channel (dual channel mode at sweep speed 5 ms/div and slower)
512 samples/channel at sweep speed 2 ms/div and faster

**Acquisition Modes:** Recurrent, single shot, multiple shot (up to 2), roll (stopped by trigger), and AUTOZOOM.

**Time Base, Real Time Sampling (Recurrent, single and multiple shot):**
PM 3350A, PM3365A: 0.5 s/div to 500 ns/div

# CombiScopes

## PM 3350A, PM 3355 60 MHz CombiScopes
## PM 3365A, PM 3375 100 MHz CombiScopes

PM 3355, PM3375: 0.5 s/div to 200 ns/div
Roll mode: 50 s/div to 1s/div
**Time Base, Equivalent Time Sampling (recurrent):** PM 3365A: 200 ns/div to 20 ns/div
PM 3375: 100 ns/div to 20 ns/div
**Timing Accuracy:** ±0.1%
**Horizontal Expansion:** x1 to × 32

### Interfacing

**GPIB/IEEE-488.1** (Option /40n): Three state bus driver (E2)
**RS-232C** (Option /50):
**Handshaking:** Software (Xon/Xoff) or hardware (DSR/DTR & CTS/RTS)
**Baud Rate:** Tx 75 to 19,200; Rx 75 to 1,200 baud
**Format:** 7 or 8 bits, odd/even/no parity, 1 or 2 stop bits

### Digital Plotter

(Only with option /40n or /50n)
**Language:** HPGL or Philips GL
**Plotter Types:** HP 7550, HP 7475A, PM 8153, PM 8154, PM 8155

### Matrix Printer

(with option /40n or /50n)
**Screen Dump:** Epson FX-80 compatibles, HP ThinkJet and compatibles
**Analog Plotter Output:** 0.1 V/div; TTL compatible penlift

## General Specifications

### Display

CRT with 8 × 10 cm viewing area, P31 phosphor, 16 kV acceleration voltage. Parallax-free graticule with continuously variable illumination. Separate backlit LCD for display of status, settings information, etc. Softkey display area on CRT for selection of menu choices.

### Power Supply

Safety requirements meet the following specifications: IEC 348 Class 1, UL 1244, CSA Certified (CSA556B), VDE 0411
**Line Voltage:** 100V to 240V ac ±10% in one range
**Line Frequency:** 50 Hz to 400 Hz ±10% in one range
**DC Nominal Voltage:** 145V to 335V
**AC Power Consumption:** PM 3350A 70W; PM 3355 80W; PM 3365A 75W; PM 3375 80W

### Mechanical Data

**Width:** 387 mm (15.2 in) incl handle; 350 mm (13.8 in) excl handle
**Length:** 518 mm (20.4 in) incl handle; 456 mm (17.9 in) excl handle incl knobs
**Height:** 146.5 mm (5.8 in) incl feet; 134.5 mm (5.3 in) excl feet
**Weight:** Approx 7.5 kg (16.5 lb) excl. accessories

## Ordering Information

### Models

**PM 3350A** 60 MHz, 100 MS/s CombiScope *$3675*
**PM 3355** 60 MHz, 250 MS/s CombiScope *$5275*
**PM 3365A** 100 MHz, 100 MS/s CombiScope *$4250*
**PM 3375** 100 MHz, 250 MS/s CombiScope *$5385*

The same instruments are available in rack mount version, increase the type number by 2 (for instance: PM 3352A)

### Included with Instrument

Three-year product warranty; (parts and labor), five-year CRT warranty; line cord; two 100 MHz 10:1 probes, model PM 8926/591 or equivalent, with 1.5m (5 ft) cable and scale factor readout; protective front cover; blue CRT contrast filter (on CRT); memory back-up batteries; Operator and reference manual; Service manual available free of charge upon return of reply card included with each instrument; Certificate of Calibration Practices.

### Optional Configurations

When ordering, select basic "PM" model number, and add the configuration option number listed below as a suffix.

**/00n** Standard Version
**/40n** with GPIB/IEEE-488 Interface *$450*
**/50n** with RS-232C Interface *$450*

These options are factory installed, or can be ordered separately as PM 8957A or PM 8958A interfaces

The **n** indicates the required line cord. To select your line cord substitute the **n** by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

### Accessories

### Passive Probes

**PM 9001/001** Modular 1:1 Probe, 1.5m (5 ft) Cable *$75*
**PM 9001/091** Modular 1:1 Probe, 1.5m (5 ft) Cable, Range Indicator *$95*
**PM 9001/201** Modular 1:1 Probe, 2.5m (8 ft) Cable *$90*
**PM 9001/291** Modular 1:1 Probe, 2.5m (8 ft) Cable, Range Indicator *$110*
**PM 9010/001** Modular 100 MHz 10:1 Probe, 1.5m (5 ft) Cable *$80*
**PM 9010/091** Modular 100 MHz 10:1 Probe, 1.5m (5 ft) Cable, Range Indicator *$110*
**PM 9010/201** Modular 100 MHz 10:1 Probe, 2.5m (8 ft) Cable *$100*
**PM 9010/291** Modular 100 MHz 10:1 Probe, 2.5m (8 ft) Cable, Range Indicator *$120*
**PM 9011/001** Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 100 MHz (in 10:1 mode), 10 MHz (in 1:1 mode) *$85*
**PM 8926/591** 10:1 Probe, 100 MHz 1.5m (5 ft) Cable, Range Indicator *$85*
**PM 9100/001** Modular 200 MHz 100:1 Probe, 1.5m (5 ft) Cable *$155*
**PM 9100/091** Modular 200 MHz 100:1 Probe, 1.5m (5 ft) Cable, Range Indicator *$180*
**PM 8918/301** Low Pass Filter Probe, Bandwidth 4 kHz *$124*
**PM 9002/001** General accessory set for PM 9000 series probes *$35*
**PM 9102/001** General accessory set for PM 9100 series probes *$40*
**PM 9003/001** Accessory extension set for PM 9000 series probes *$70*

### Active Probes

**PM 8940/09n** High Voltage Isolation Amplifier *$1120*
**PM 9355/09n** 70 MHz AC Current Probe *$1350*
**80i-110s** AC/DC Current Probe for Oscilloscopes *$395*

### Other Accessories

**PM 8902A/001** 12V DC Power Inverter *$320*
**PM 8903A/00n** Battery Pack, Charger, Inverter and Carrying Case *$680*
**PM 8917/00n** NTSC and PAL Video Sync Separator and Line Selector *$720*
**PM 8957A/00n** Retrofittable GPIB/IEEE-488 Interface *$790*
**PM 8958A/001** Retrofittable RS-232C Interface *$790*
**PM 8969/001** Retrofittable Rackmount Kit *$330*
**PM 8989/001** Traveller Carrying Case *$175*
**PM 8989/031** Traveller Carrying Case with Accessory Storage Compartments *$140*
**PM 8991/041** Oscilloscope Cart *$575*
**PM 8992/651** Accessory Pouch *$55*
**PM 9051/001** BNC male to 4 mm Banana Adapter/Binding Posts *$27*
**PM 9074/001** 50Ω Coaxial Cable 1m (3 ft) *$27*
**PM 9381/001** Oscilloscope Camera System *$875*
**80i-500s** AC current probe for oscilloscopes *$170*
**80i-1000s** AC current probe for oscilloscopes *$395*
**TC100** Instrument Cart *$540*

### Oscilloscope Supporting Software

**PM 2273** AnyWave™ *$295*

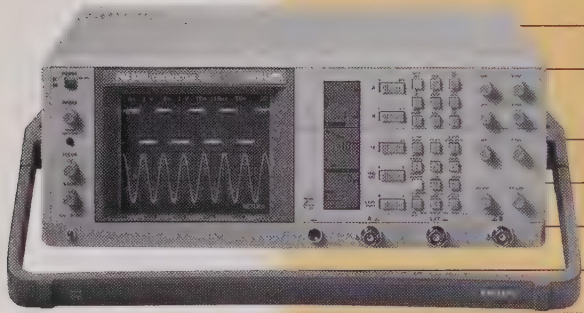
## Customer Support Services

### Factory Warranty

Three-year product warranty. Five-year CRT warranty.

## PM 3331 & PM 3335 CombiScopes

- Full featured Digital Storage Oscilloscopes with a true analog scope built-in
- 40 or 60 MHz analog bandwidth
- 20 MS/s synchronous real time sample rate on each channel
- Deep 8K bytes × 8-bit waveform acquisition memory even at max sample rate
- Reference memory for comparison of waveforms
- AUTOSET for instant on-screen trace display
- Versatile cursors for many on-screen measurements
- RS-232C interface for hard copy and remote control
- GPIB/IEEE-488 optional
- Options include RS-232C interface with AnyWave communication software package or GPIB/IEEE-488



PM 3331

### Two Scopes in One

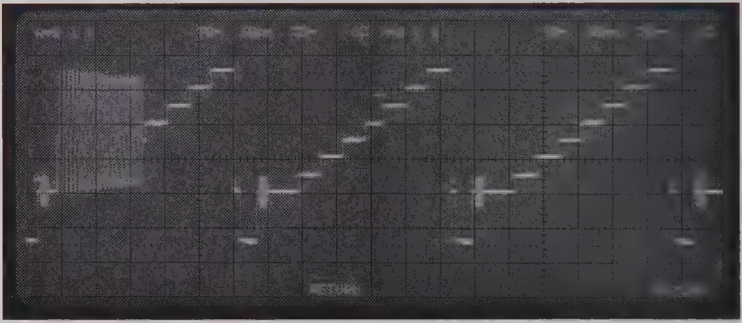
The PM 3331 and PM 3335 set a standard in performance and economy. Each instrument is two professional scopes in one: it operates as a real time 40 or 60 MHz analog oscilloscope and at the touch of a button, becomes a full function digital storage oscilloscope. Now, you have the power for digital capture and analysis of elusive single shots with a full 20 MS/s sample rate on each channel simultaneously. Unlike some scopes in this class, the full sample rate is maintained for all channel combinations, giving a single event resolution of 50 ns for both channels.

### Measurement Cursors as Standard

Independent voltage and time cursors make signal measurements both accurate and fast. Along with measurement of voltage and time differences (dV, dt), the measurement functions include selection of ratio, phase and track. To aid the user further, a simple frequency calculation is made by 1/dt. Positioning cursors on the easily identified 10% and 90% of peak-to-peak value gives a rise/fall time readout.

### Powerful Triggering

The PM 333x's deep memory can also be used to show extensive pretrigger information. Unlike a conventional scope, a DSO can pretrigger, i.e. capture and display events prior to a trigger event that initiates the acquisition. This function is very useful in showing, for example, the complete leading edge of a pulse waveform for rise/fall time measurement (compared to an analog scope that can only show the waveform from the trigger moment on). Another example is in examining signals or transients leading up to the trigger edge. In the PM 333x, up to 20 divisions of pretrigger information can be captured and analyzed.



The deep 8k memory gives you double-length viewing for single-channel acquisition, even at the maximum sample rate. Now you can see more of the "picture" with the PM 3335.

### Two Interfaces in One

The PM 333x has communication facilities normally only expected in instruments in much higher price ranges. RS-232C gives full remote control of all relevant instrument settings, as well as waveforms transfer and hardcopy capability. On PM 3335, this can be expanded with a GPIB/IEEE-488 interface, so that both interfaces can be used for control and hardcopy purposes. Another option includes full RS-232 plus the AnyWave software package and communication cable, providing you with a complete set to automate signal capture and storage in the PC. In addition, it gives you the capability to compare acquired waveforms with reference curves from previous acquisitions or created on the PC. Stored traces can be incorporated into most popular word processors for easy and professional documenting, or into spreadsheets for further analysis.

### Simple to Operate

While the PM 333x offers capabilities seen never before in a cost-effective scope, this is not at the expense of ease of use. Ergonomics was a vital element in design of the instrument:

- Direct parameter readout of the present set-up on an LCD panel for at-a-glance checking of the setup.
- Fast action up/down controls give finger tip setting of range values quickly and securely. Reliability is guaranteed by cold switching through microprocessor control. All rocker keys are located directly next to the clear LCD for readout and immediate confirmation of set-up.
- Front panel layout is logical, with similar functions grouped together for instant recognition.
- Softkeys are positioned directly under the CRT display, mounted flush in the screen bezel. Softlabels appear on the screen just above these keys.

The result is an instrument that is readily understood and easy to use, while offering a versatile capability for fast problem solving.

GPIB
IEEE-488
RS-232

# PM 3331 & PM 3335 CombiScopes

### AUTOSET

Another first for the PM 3335 and PM 3331 is its full function AUTOSET. A single push of the AUTOSET button and any signal is automatically scanned and an optimum display of the trace is provided. It is not a factory preset, but is a full automatic set-up of time base and amplitude parameters depending on the incoming input signal. In addition, each channel is searched for a signal and if no signal is present, that channel is not displayed. Moreover, the AUTOSET selects the best trigger source for maximum trace stability. No other manufacturer gives you all these facilities for such a low price.

## Specifications

### Technical Specifications

**AUTOSET:** Automatically selects proper channel(s), trigger and time base mode, and scales the display for proper amplitude and timing. Autoset operates in the analog, as well as the digital storage modes.

### Analog Mode

#### Vertical

**Analog Display Modes:** Ch A, Ch B, -Ch B, Ch A + Ch B, Ch A - Ch B; ALTernate or CHOPped
**Frequency Response:** DC to >60 MHz (40 MHz in PM 3331) at -3 dB (20 mV/div to 10 V/div); dc to >35 MHz, at -3 dB (2 mV/div to 10 mV/div); in ac coupling lower -3 dB point is <10 Hz
**Rise Time:** <5.8 ns (20 mV/div to 10 V/div); (<8.8 ns in PM 3331) <10 ns (2 mV/div to 10 mV/div)
**Deflection Coefficient:** 2 mV/div to 10 V/div (±3%) in 1, 2, 5 sequence. Continuous control ratio between steps 1 to >2.5
**Input Impedance:** 1 MΩ ±2% // 20 pF ±2 pF
**Maximum Input Voltage:** 400V (dc + ac peak)
**Dynamic Range:** >24 div at 10 MHz
**CMRR:** 100:1 at 1 MHz
**Input:** BNC with automatic probe recognition

#### Horizontal

**Display Modes:** Time base (for Y-t operation) or X vs Y display
**Time Base:** 0.5 s/div to 50 ns/div (±3%) in 1, 2, 5 sequence. Continuous control ratio between steps 1 to >2.5
**Expansion:** x10, fastest sweep speed 5 ns/div. Error limit in x10: ±4%

#### Triggering

**Trigger Modes:** Auto (free run), normal (triggered) single sweep
**Trigger Sources:** Ch A, Ch B, composite (Ch A, Ch B), External (dc or ac); line
**Trigger Coupling:** Auto peak-to-peak (p-p), dc, TVF, TVL, LF Reject, HF Reject

#### Trigger Sensitivity

| | Internal | External |
|---|---|---|
| 10 MHz | 1.0 div | 100 mV |
| 50 MHz | 1.0 div | 150 mV |
| 100 MHz | 3.0 div | 500 mV |
| TVF/TVL | 0.7 div sync | 70 mV sync |
| Level Range | ±8 div | ±800 mV |

Slope, positive or negative; TVF or TVL, positive or negative

#### X-Deflection

**Deflection Coefficient:** Via Ch A or Ch B: 2 mV/div to 10 V/div; via Ext input: 100 mV/div
**Frequency Response:** DC to 2 MHz
**Error Limit:** ±5%
**Phase Shift:** <3° up to 100 kHz

#### External Input

**Impedance:** 1 MΩ ±2% // 20 pF ±2 pF
**Maximum Input Voltage:** 400V (dc + ac peak)

### Digital Mode

All specifications as analog mode unless otherwise stated

#### Acquisition

**Sample Rate:** 20 MS/s max. on two channels simultaneously

#### Vertical

**Resolution:** 8 bit
**Display Modes:** Ch A, Ch B, -Ch B
**Frequency Response:** DC to >5 MHz, −3 dB (2 mV/div to 10 V/div)

#### Horizontal

**Modes:** Recurrent, single shot, multiple shot (up to 2)
**Resolution:** single channel 8192 samples/channel; dual channel 4096 samples/channel

#### Time Base

**Time Base Speed:** 50 s/div to 10 µs/div real time sampling
**Timing Accuracy:** ±0.01%
**Display Expansion:** x1 to x32
**Trigger Delay:** 20 divisions of pretrigger view
**Display Expansion:** x0.5 to x32 horizontal

#### Memory

**Storage Registers:** 2
**Number of Traces Stored in Each Register:** Up to 2
**Depth of Acquisition Memory:** 8192 words
**Depth of Reference Memory:** 8192 words
**Vertical Memory Resolution:** 8 bit
**Display Modes:** Ch A, Ch B, Register A, Register B in any combination

#### Cursors

**Horizontal Resolution:** (all display modes) 1:1000 over 10 divisions
**Vertical Resolution:** 1:200 over 8 divisions
**Read Out Resolution:** 3 digits
**Measurements:** dV, dt, 1/dt, ratio, phase

#### GPIB/IEEE-488 (Option/40n)

Provides control over all switchable functions, including acquisition and measurement functions. Waveform data can be transferred from scope to controller and back, and measurement results and instrument settings can be read by the controller.
**Bus Driver:** E2 (three state)
**Function Repertoire:** SH1, AH1, T5, L3, SR1, RL2, PP0, DT1, DC1, C0

#### RS-232C
(Options /40n, /60n, /80n)

Provides control over all switchable functions, including acquisition and measurement functions. Waveform data can be transferred from scope to PC and back, and measurements results and instruments settings can be read by the PC.
**Handshake:** Software Xon/Xoff, hardware DSR/DTR and CTS/DTR
**Baud Rate:** Transmit and receive 75 to 4800 bits/sec, 9600 baud dump only
**Character Length:** 7 or 8 bits, 1 or 2 stop bits; odd, even or no parity

#### RS-232C Dump-only Interface
(Option /50n)

Provides hardcopy to printer and plotter
**Handshake:** Software Xon/Xoff, hardware DSR/DRT and CTS/DTR
**Baud Rate:** Transmit and receive 75 to 4800 bits/sec, 9600 baud dump only
**Character Length:** 7 or 8 bits, 1 or 2 stop bits; odd, even or no parity

#### Digital Plotter

**Language:** HP GL or Philips GL, dependent on plotter type selected
**Plotter Select:** HP 7550, HP 7475A, Philips PM 8153, PM 8154, PM 8155
**Pen Select:** Pen 1 for Ch A; Pen 2 for Ch B; Pen 3 for Register Ch A; Pen 4 for Register Ch B; Pen 5 for graticule and alphanumerics
**Plot Area:** Softkey selectable

#### Dot Matrix Printer Screen Dump

**Screen Dump:** Compatible with Epson FX Series and HP Thinkjet™ graphics protocol and compatibles
**Drawing Area:** 10 cm × 10 cm

#### Optional AnyWave Communication Software

Document your captured waveform in any popular word processor or spreadsheet program

- Archive your waveforms to create your own reference library
- Analyze captured waveforms and measurement data
- Create or edit new and captured waveforms or envelopes

# CombiScopes

## PM 3331 & PM 3335 CombiScopes

### General Specifications

#### Display

**Screen:** CRT with 8 × 10 cm viewing area; P31 phosphor; 16 kV acceleration voltage. Softkey display area on CRT for selection of menu choices.
**Graticule:** Parallax-free with continuously variable illumination
**LCD Display:** Separate constantly backlit LCD for display of status information, settings, etc

#### Power Supply

**Line Voltage Range:** 100V to 240V ac ±10% in one range
**Line Frequencies:** 50 Hz to 400 Hz ±10% in one range
**Power Consumption:** 55W

#### Environmental Data

Meets requirements of MIL-T-28800C, Type III, Class-5, Style D, as specified below

**Temperature**
**Rated Range of Use:** +10°C to +40°C
**Operating Range:** 0°C to +50°C
**Storage:** −40°C to +75°C
**Altitude**
**Operating:** 4,500m (15,000 ft)
**Transport:** 12,000m (40,000 ft)
**EMI:** Meets requirements of MIL-STD-461 Class B, VDE 6871 and VDE 0875 Grenzwertklasse B
**Shock:** Operating and non-operating: Max acceleration 30g, ½ sine, 11 ms duration, 6 shocks on each axis, 3 shocks on each face giving a total of 18 shocks
**Bench Handling:** MIL-STD-810 method 516, procedure V
**Safety:** Meets requirements of IEC 348 Class 1, VDE 0411, UL 1244, CSA Certified (CSA556 B)
**CE:** Compliant as of January 1996

#### Mechanical Data

**Width:** 387 mm (15.2 in) incl handle; 350 mm (13.8 in) excl handle
**Length:** 518 mm (20.4 in) incl handle; 456 mm (17.9 in) excl handle, incl knobs
**Height:** 146.5 mm (5.8 in) incl feet; 134.5 mm (5.3 in) excl feet
**Weight:** Approx 9.5 kg (20.9 lb) excl accessories

## Ordering Information

### Models

**PM 3331/50n** 40 MHz, 20 MS/s CombiScope, RS-232C hard-copy dump-only interface (available in Europe only)
**PM 3331/80n** 40 MHz, 20 MS/s CombiScope, with RS-232C interface + AnyWave software package + PM 8914 RS-232 cable (available in Europe only)
**PM 3335/00n** 60 MHz, 20 MS/s CombiScope, without interface (available in USA only) *$2075*
**PM 3335/60n** 60 MHz, 20 MS/s CombiScope, with full RS-232C interface *$2285*
**PM 3335/80n** 60 MHz, 20 MS/s CombiScope, with full RS-232C interface + AnyWave software package + PM 8914 RS-232 cable *$2495*
**PM 3335/40n** 60 MHz, 20 MS/s CombiScope, with GPIB/IEEE-488.1 and full RS-232C Interface. *$2525*
**PM 3337/x0n** As PM 3335/x0n, with Rack Mount *$2285*

### Included with Instrument

Three-year product warranty, parts and labor, five-year CRT warranty; line cord; Protective front cover (PM 3335 only); memory back-up batteries; two 100 MHz 10:1 probes, model PM 8926/591 or equivalent, with 1.5m (5 ft) cable and scale factor readout; blue CRT contrast filter; operator and reference manual; a service manual is available upon return of reply card included with each instrument; Certificate of Calibration Practices.

The **n** indicates the required line cord. To select your line cord substitute the **n** by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

### Accessories

#### Passive Probes

**PM 9001/001** Modular 1:1 Probe, 1.5m (5 ft) Cable *$75*
**PM 9001/201** Modular 1:1 Probe, 2.5m (8 ft) Cable *$90*
**PM 9010/001** Modular 100 MHz 10:1 Probe, 1.5m (5 ft) Cable *$80*
**PM 9010/091** Modular 100 MHz 10:1 Probe, 1.5m (5 ft) Cable, with Range Indicator *$110*
**PM 9010/201** Modular 100 MHz 10:1 Probe, 2.5m (8 ft) Cable *$100*
**PM 9010/291** Modular 100 MHz 10:1 Probe, 2.5m (8 ft) Cable, with Range Indicator *$120*
**PM 9011/001** Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 100 MHz (in 10:1 mode), 10 MHz (in 1:1 mode) *$85*
**PM 8926/591** 10:1 Probe, 1.5m (5 ft) Cable, Range Indicator *$85*
**PM 9100/001** Modular 200 MHz 100:1 Probe, 1.5m (5 ft) Cable *$155*
**PM 9100/091** Modular 200 MHz 100:1 Probe, 1.5m (5 ft) Cable, Range Indicator *$180*
**PM 8918/301** Low-Pass filter probe, 4 kHz bandwidth *$124*
**PM 9002/001** General accessory set for PM 9000 series probes *$35*
**PM 9102/001** General accessory set for PM 9100 series probes *$40*
**PM 9003/001** Accessory extension set for PM 9000 series probes *$70*

#### Active Probes

**PM 8940/09n** High Voltage Isolation Amplifier *$1120*
**PM 9355/09n** 70 MHz AC Current Probe *$1350*

#### Other Accessories

**PM 8902A/001** 12V DC Power Inverter *$320*
**PM 8903A/00n** Battery Pack, Charger, Inverter and Carrying Case *$680*
**PM 8914/001** CombiScope Serial Interface Cable *$50*
**PM 8917/00n** NTSC and PAL Video Sync Separator and Line Selector *$720*
**PM 8969/001** Retrofittable Rackmount Kit *$330*
**PM 8988/001** Protective Front Panel Cover for PM 3331 *$55*
**PM 8989/001** Traveller Carrying Case *$175*
**PM 8989/031** Traveller Carrying Case with Accessory Storage Compartments *$140*
**PM 8991/041** Oscilloscope Cart *$575*
**PM 8992/651** Accessory Pouch *$55*
**PM 9051/001** BNC male to 4 mm Banana Adapter/Binding Posts Adapter *$27*
**PM 9074/001** 50Ω Coaxial Cable 1m (3 ft) *$27*
**PM 9075/001** 75Ω coaxial cable 1 m (3 ft) *$27*
**PM 9072/001** Coaxial cable 135Ω, BNC male to banana plugs, 1 m (3 ft) *$65*
**PM 9585/011** 50Ω Feedthrough Termination, 1W *$60*
**PM 9381/001** Oscilloscope Camera System *$875*
**80i-110s** AC/DC current probe for oscilloscopes *$395*
**80i-500s** AC current probe for oscilloscopes *$170*
**80i-1000s** AC current probe for oscilloscopes *$395*
**TC100** Instrument Cart *$540*

### Oscilloscope Supporting Software

**PM 2273** AnyWave *$295*

### Customer Support Services

**Factory Warranty**
Three-year product warranty. Five-year CRT warranty.

All options are factory installed only.

# Analog Oscilloscopes

## PM 3082, PM 3084 100 MHz; PM 3092, PM 3094 200 MHz Analog Oscilloscopes

Choice of 100 MHz or 200 MHz bandwidths

True 4-channel models have 4 complete and independent signal inputs

Exceptional 1% voltage and timing accuracy

AUTOSET for instant, optimized display

Delayed Time Base with full trigger capabilities

Advanced trigger facilities include HDTV and on-screen trigger level display

Powerful cursor measurements with direct numeric readout

Automatic voltage peak to peak measurements

Probe recognition, automatic or manually selectable

Standard RS-232C interface, GPIB/IEEE-488.2 (optional)

Calibration intervals up to 2 years

FLUKE PM3094

PM 3094

### The New 100 MHz and 200 MHz 4-Channel Analog Standard

These new analog scopes set the new 100 MHz and 200 MHz standard, giving you the brightest, sharpest trace in their class. In combination with their competitive price level, that means the greatest possible value for money. These scopes will meet all your requirements – today as well as tomorrow.

### Full 4-Channel Capabilities

This new range of true 4-channel oscilloscopes give you significant advantages over conventional 2-channel instruments. The 4 separate inputs allow fully independent full-range sensitivity setting on all channels — an important benefit in many situations where you need to examine the relationships between more than 2 signals. These advanced 4-channel capabilities are ideal for situations like 3-phase measurements, checking RGB video signals, circuits with multiple digital signals, or mixed digital/analog circuits. Another powerful function is differential measurements — use the 4 inputs to display 2 difference signals, both of which can be examined and measured simultaneously.

### Choice of 2 + 2 Channel Models

Next to the advanced 4-channel models, this new range of analog scopes also includes two very competitively priced models with 2 + 2 channel inputs and a choice of 100 MHz and 200 MHz bandwidths. These two models are ideal general-purpose oscilloscopes for use in environments like service and training, where top value is an essential requirement.

### Simple, Familiar Operation

For a fast, optimized display of any input signal, all you have to do is press the green AUTOSET button. You can even customize the AUTOSET function using the set-up menu to meet your own preferences. Next to the traces, the screen display also shows you channel identifiers and ground level indicators, plus numeric readouts of exact measured values and instrument settings. This means that all the information you need is clearly displayed on-screen, making these scopes even easier and more convenient to use.

The clear and logical front-panel lay-out makes operation easier and further reduces the chances of errors. There's a single button for every major function, giving you direct access to the mode you want. And to control the 4 input channels, you'll find 4 corresponding front-panel sections — each with its own attenuation and time base settings. Measurement set-up is simplified by automatic probe recognition. So all you need to do is connect your test signals, press AUTOSET and take the measurement you want. Operation and settings are computer-controlled, reducing the chance of error and maximizing speed and convenience.

The unique probe mounted command switch gives you the control over the front panel right under your thumb. Simply press the command switch to select another predefined instrument set-up from the front panel memory, or to initiate Autoset. Without the need to move away from the system under test.

### Constant High Accuracy – Always Calibrated

Ensuring optimum accuracy in all operating environments, these new analog scopes have a built-in AUTOCAL function. Just push a button, and all basic instrument settings are fine-tuned to their specified values. Which means your measurements are sure to be within the high ±1% accuracy for both time and amplitude. AUTOCAL ensures that accuracy is always maintained, by compensating for changes in ambient conditions like temperature and humidity.

These new analog scopes are always calibrated, even in the variable range between the normal 1, 2, 5 amplitude or time base settings. This AUTOCAL function means that you can now set up the scope for the best visual display, without compromising on measurement accuracy. Helping you to save time, increasing the accuracy of your results, and avoiding mistakes.

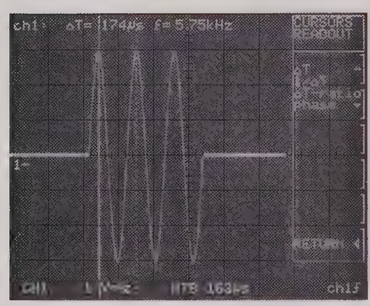
| | PM 3082 | PM 3084 | PM 3092 | PM 3094 |
|---|---|---|---|---|
| Bandwidth | 100 MHz | 100 MHz | 200 MHz | 200 MHz |
| Channels | 4 (2+2) | 4 | 4 (2+2) | 4 |
| Max. sensitivity | 2 mV/div. | | | |
| Max. sweep speed (MTB and DTB) | 5 ns/div. | | 2 ns/div. | |
| Input impedance selection | 1 MΩ//25 pF | | 50Ω and 1 MΩ//25 pF | |
| Accuracy | 1% voltage and timing | | | |
| Acceleration voltage | 16.5 kV | | | |
| Bandwidth limiter | 20 MHz | | | |
| Front-panel storage | 10 set-ups with battery back-up | | | |

GPIB IEEE-488

RS-232

# Analog Oscilloscopes

## PM 3082, PM 3084 100 MHz; PM 3092, PM 3094 200 MHz Analog Oscilloscopes

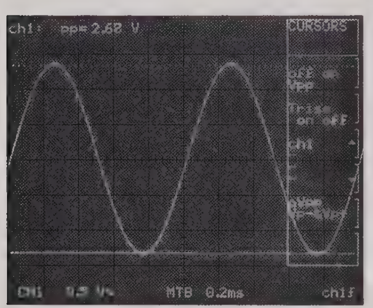


Powerful cursor measurements with direct numeric readout and unprecedented 1% accuracy.

### Fast Cursor and Voltmeter Measurements

As far as measurements are concerned, these new scopes will give you the results you want - fast. A wide range of cursor measurements give you instant voltage and timing data through a direct on-screen read-out. Available measurement modes include dt, 1/dt (in Hz), dt ratio, phase, dV, dV ratio and $V_{abs}$.

Making your measurements fast and simple, automatic cursor positioning helps you instantly to locate voltage min./max. values, allowing fully automated $V_{p-p}$ measurements.

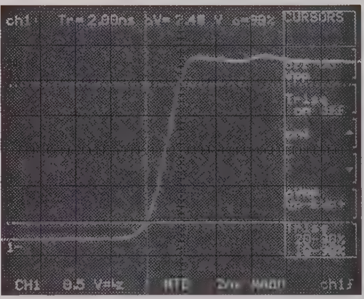


Automatic cursor positioning at min/max voltage values allowing fully automated $V_{p-p}$ measurements.

Rise time measurements, too, are made instantly thanks to automatic cursor positioning at either the 10/90% or 20/80% levels. And as these measurements can even be made with variable amplitude or time settings, you can always measure to the highest possible accuracy.

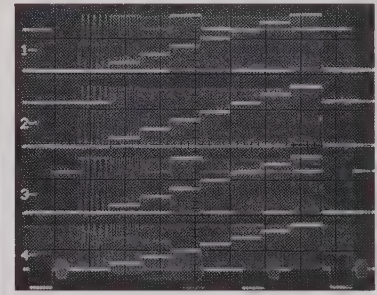
### Maximum Signal Detail

The bright, high-resolution CRT gives you a crisp display that's always easy to read. The advanced CRT design, together with the highly accurate input circuitry, ensures high sensitivity, with a clear, low-noise image.



Automatic positioning of voltage cursor for rise time measurements selectable at 10-90% or 20-80% levels.

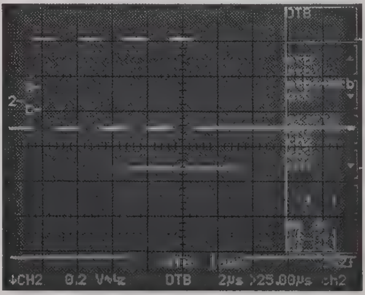
To get the maximum information out of expanded signal details of interest, you'll find a Delayed Time Base facility, with a fast sweep speed of up to 2 ns/div. And like all Fluke oscilloscopes with delayed sweep, these new instruments have independent trigger settings for both Main and Delayed Time Bases.



High brightness CRT shows complete signal detail.

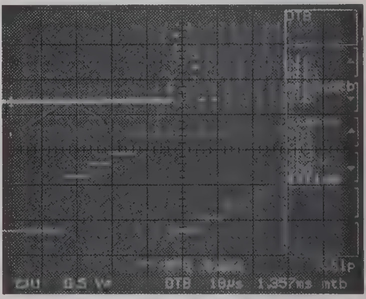
### Versatile Triggering Including HDTV

Versatile triggering is a strong point of these new oscilloscopes. The powerful triggering facilities include on-screen level display, HF/LF reject filters, TV-frame and -line triggering. You can widen the trigger gap to ensure stable triggering, in case of noisy signals.



Delayed time base, 2 ns/div. with full trigger capabilities to zoom in on signal details.

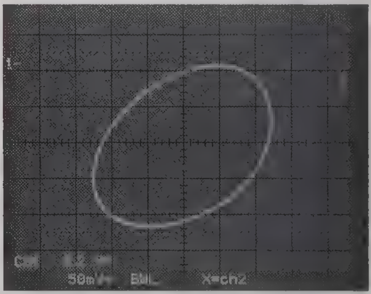
You can also trigger on the 3-level HDTV sync., as found in high resolution imaging systems.



Super stable video triggering on both main and delayed sweep enable detailed examination of video signals.

### Compact, Portable and Reliable

High component integration and SMD technology make these oscilloscopes compact and lightweight. At the same time, maximizing reliability over a long, trouble-free lifetime. In addition, computer-controlled analog circuits with cold switching and digital potentiometers eliminate wear and drift and resist contamination.



HDTV 3 level sync.

### Quality That's Designed-In and Built-In

Every Fluke oscilloscope has quality that's designed-in and built-in right from the start. That means not only reliability and durability, but also an excellent EMI and environmental specification, meeting virtually all requirements in these areas. Our advanced, highly automated manufacturing facilities produce instruments that give you dependable performance, while ISO 9001 certification provides a guarantee of consistent high quality.

Contributing further to the exceptionally low cost of ownership, these new scopes have closed-case calibration facilities and extended intervals between calibrations, saving you external cal lab costs.

Calibration intervals can be as long as two years, if 2% accuracy is sufficient. These instruments have a sturdy, rugged construction that allows them to withstand

## PM 3082, PM 3084 100 MHz; PM 3092, PM 3094 200 MHz Analog Oscilloscopes

tough everyday operating conditions in service workshop, development lab or production line environments. Like all Fluke oscilloscopes, these new analog scopes meet all major certification requirements including CSA 665B.

# Specifications

## Technical Specifications

**AUTOSET:** Selects proper channel-, time base- and trigger settings. Function can be customized by the user.
**AUTOCAL:** Automatic fine adjustment for enhanced accuracy to get optimal performance even under extreme environmental conditions.
**COMMAND SWITCH:** Probe mounted button that provides control of user selected functions without having to reach for the control panel of the instrument. Can be used to initiate a complete Autoset, to temporarily show a baseline for reference purposes, or to select the next setting from an array of pre-defined instrument set-ups.

### Vertical Deflection

**Input Channels:** Four fully attenuated channels or four (2+2) channels (PM 3092/PM 3082)
**On Screen Indicators:** Channel identifiers with ground level indication
**Display Modes:** CH1, CH2 (invert), CH3, CH4 (invert), Add: CH1 (±)CH2, CH3 (±) CH4. ALTernate or CHOPped mode.
**Frequency Response:** DC to >200 MHz at −3 dB or to >100 MHz at −3 dB (PM 3084/PM 3082)
**In AC Coupled Mode:** Lower −3 dB point: <10 Hz
**Bandwidth Limiter:** 20 MHz at − 3 dB
**Rise Time:** <1.75 ns (calculated from bandwidth) or <3.50 ns (PM 3084/PM 3082)
**Deflection Coefficient:** 2 mV/div to 5 V/div in a 1-2-5 sequence or continuously calibrated control: 2 mV/div to 12.5 V/div
**Channel 3 and 4:** 0.1 V/div and 0.5 V/div (PM 3092/PM 3082)
**Error Limit:** 1.3% (measured over central 6 divisions)
**Input Impedance:** 1 MΩ ±1%// 25 pF ±2 pF and 50Ω ±1% (PM 3094 and CH1 & 2 of PM 3092)
**Max. Rated Input Voltage:** In 1 MΩ position: 400V (dc + ac peak; <10 kHz); In 50Ω position: 5V rms, 50V ac-peak (maximum of 50 mJ during any 100 ms interval)
**Dynamic Range:** 24 div at 50 MHz (25 MHz PM 3082/PM 3084); 8 div at full bandwidth (100 or 200 MHz)
**CMRR:** 100:1 at 1 MHz, 25:1 at 50 MHz
**Channel Isolation:** 50:1 at full bandwidth (100 or 200 MHz)

### Horizontal

**Display Modes:** Main TB and/or Delayed TB, X-deflection (=X vs.Y-mode)

### Main Time Base

**Time Coefficients:** 0.5 s/div to 20 ns/div in a 1-2-5 sequence or continuously calibrated control: 1.25 s/div to 20 ns/div. For PM 3084 and PM 3082 the fastest time base setting is 50 ns/div.
**Fastest Sweep (magn × 10):** 2 ns/div; 5 ns/div on PM 3084/PM 3082
**Error Limit (magn 1x):** ± (1.3% of reading + 0.5% of 8 divisions)
**Hold-off:** Up to 20 div of MTB setting (max 2 sec.)

### Delayed Time Base

**Time Coefficients:** 0.5 s/div to 20 ns/div in a 1-2-5 sequence or 0.5 s/div to 50 ns/div (PM 3084/PM 3082)
**Fastest Sweep (magn × 10):** 2 ns/div; 5 ns/div on PM 3084/PM 3082
**Error Limit (magn 1x):** ± (1.3% of reading + 0.5% of 8 divisions)
**Trace Separation:** ±>4 div

### Delay Time Multiplier

**Resolution:** 1:40,000
**Error Limit (magn x1):** ± (0.8% of reading + 0.3% of 8 divisions + 4 ns)
**Jitter:** 1:25,000

### Triggering (MTB & DTB)

**Trigger Modes:** Auto free run, Triggered, Single; Edge triggering, TV triggering

### Edge Triggering

**MTB Trigger Source:** CH1 to CH4, Composite, Line (mains)
**DTB Trigger Source:** Starts, or triggered by CH1 to CH4
**Slope:** Positive (+) or negative (−)
**Coupling:** DC, AC (10 Hz), LF-rej (30 kHz), HF-rej (30 kHz) (≥10 Hz)
**Level Range:** ±8 div or level within signal peak-peak range
**Level Indication:** On screen level indicators and numeric readout

### Trigger Sensitivity

**PM 3094/PM 3092:** 0.6 div up to 100 MHz, 1.2 div up to 200 MHz, 2.0 div up to 300 MHz
**PM 3084/PM 3082:** 0.6 div up to 50 MHz, 1.2 div up to 100 MHz, 2.0 div up to 200 MHz

### TV Triggering

**Video Standard:** HDTV, NTSC, PAL, SECAM
**MTB Trigger Source:** CH1 to CH4; Field 1, Field 2, TV-line
**DTB Trigger Source:** Starts, CH1 to CH4 edge, TV-line
**Signal Polarity:** Positive or negative
**Sensitivity:** 0.7 div (sync. pulse)

### X-Deflection

**Deflection Source:** CH1 to CH4, Line (= mains)
**Deflection Coefficient:** Same as vertical deflection
**Dynamic Range:** 20 div up to 100 kHz; >10 div up to 2 MHz
**Frequency Response:** −3 dB at ≥ 2 MHz
**Error Limit:** 5% measured over central 6 divisions
**Phase Shift:** <3° up to 100 kHz

### Cursor Measurements

**Cursor Modes:** Manual positioning: Horizontal, Vertical, Both
**Auto Positioning:** $V_{p-p}$ or 10-90% or 20-80%
**Readout (mode dependent):**
Vertical: dV, V1&V2 to GND, Ratio
Horizontal: dT, 1/dT (in Hz), Ratio, Phase;
Auto positioning: Vpp, Vp+&Vp- to GND, Vdc, and Trise
**Accuracy (magn x1):** 1% of full scale (within the central 8 horizontal and 6 vertical division for manual cursor positioning).

### Interfaces

**RS-232C:** DB-9 male connector
**Handshake:** DSR/DTR, CTS/RTS and Xon/Xoff
**Baudrate:** 75 to 38400
**Format:** 1 stopbit; 7 or 8 databits; odd/even/no parity
**Protocol:** CPL = Compact Programming Language = reduced set of powerful instructions for remote control
**GPIB/IEEE-488.2*:** Factory installed option
**Protocol:** SCPI = Standard Commands for Programmable Instruments = IEEE standardized protocol

## General Specifications

### Miscellaneous

**DISPLAY:** 8 × 10 cm viewing area, 16.5 kV acceleration voltage. Parallax free graticule with continuously variable illumination. On screen readout.
**Setting Memory:** 10 instruments setups, non volatile. Recall from front panel or from probe mounted command switch.
**Calibration Output:** 2 kHz square, 600 mV peak-peak
**Z-Modulation Input:** BNC, 10 kΩ >2.4V = blanked, <0.5V = unblanked trace
**Time Between Calibration:** 2000h or 1 year for specified accuracy. 4000h or 2 years if error limits are doubled

### Power Supply

**Line Voltage:** 100V to 240V (±10%) in one range
**Line Frequency:** 50 Hz to 400 Hz (±10%)
**Power Consumption:** 60W (80W with all options installed)

### Environmental Data

**Meets Requirements of:** MIL-T-28800D Type III, Class 3, Style D, Color R, as specified below.
**Temperature:** 0°C to +50°C (operating), +5°C to +40 °C (use), −40°C to +70°C (storage)

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*The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

# Analog Oscilloscopes

## PM 3082, PM 3084 100 MHz; PM 3092, PM 3094 200 MHz Analog Oscilloscopes

**Humidity:** 95% (storage)
**Altitude:** 4.6 km = 15.000 ft (operating), 12 km = 40.000 ft (transport)
**Vibration:** Frequency 5 Hz to 55 Hz, maximum acceleration at 55 Hz 30 m/s$^2$
**Shock:** 6 shocks along each axis, half sine wave, 6 to 9 msec, peak acceleration 400 m/s$^2$
**Bench Handling:** Meets MIL-STD-810, method 516, procedure V
**Safety:** Meets requirements of IEC 348 Class I, UL 1244, VDE 0411, CSA C22.2 No 231 approved
**EMI:** VDE 0871 Grenzwertklasse B; MIL-STD-461C: CE01 Part 2 (narrow band), CE03 Part 4, CS01 Part 2, CS06 Part 5 (300V max.), RE01 Part 5 and 6, RE02 Part 2 (1 GHz max.)
**CE:** Compliant as of January 1996

### Mechanical Data

**Fan:** Proportionally regulated forced air
**Width:** 391 mm (15.4 in) incl. handle; 341 mm (13.4 in) excl. handle.
**Length:** 551 mm (21.7 in) incl. handle; 481 mm (18.9 in) excl. handle.
**Height:** 147 mm (5.8 in) incl. feet; 139 mm (5.5 in) excl. feet.
**Weight:** 8.5 kg (20 lb)

### Auxiliary Output/External Trigger Option

**Factory Installed Option Includes:**
**Y-Out:** BNC, 50Ω, 10 mV/div into 50Ω, 20 mV/div into 1 MΩ
**MTB-Gate-Out:** BNC, 1 kΩ, TTL compatible levels
**DTB-Gate-Out:** BNC, 1 kΩ, TTL compatible levels
**External Trigger Input** (with the following specs)
**MTB Trigger Source:** CH1 to CH4, composite, external
**Impedance:** 1 MΩ
**Coupling:** AC, DC, LF-rej (30 kHz), HF-rej (30 kHz)
**Slope:** Positive (+) or negative (−)
**Trigger Gap:** 80 mV; trigger gap can be doubled for triggering on noisy signals
**Bandwidth:** Sensitivity at 10 MHz: better than 200 mV
**Input Amplifier:** Dynamic range of the dc coupled input amplifier: −2.5V to +2.5V (on BNC connector); −25V to +25V (on probe tip of 1:10 probe)
**Maximum Input Voltage:** 400V peak (dc + ac peak)

## Ordering Information

### Models

**PM 3082** 100 MHz Analog Oscilloscope with 2 + 2 Channels and Delayed Time Base *$2390*
**PM 3084** 100 MHz Full 4 Channel Analog Oscilloscope with Delayed Time Base *$2600*
**PM 3092** 200 MHz Analog Oscilloscope with 2 + 2 Channels and Delayed Time Base *$3375*
**PM 3094** 200 MHz Full 4 Channel Analog Oscilloscope with Delayed Time Base *$3800*

### Included with Instrument

Three-year product warranty, part and labor; five-year CRT warranty; Two wide bandwidth 10:1 probes (PM 9020/091 or PM 9010/091), with 1.5m (5 ft) cable, scale factor readout and probe command switch; blue CRT contrast filter (on CRT); front cover; operator and reference manual; SCPI programming manual (IEEE-488 versions only); service manual upon return of reply card included with each instrument; and Certificate of Calibration Practices.

### Optional Configurations

When ordering, select basic 'PM' model number, and add the configuration option number listed below as a suffix.
**/00n** Standard Version
**/40n** GPIB/IEEE-488 Interface *$550*
**/73n** Ch1 Signal Output, MTB Sweep and MTB + DTB Gate Outputs *$275*
**/93n** GPIB/IEEE-488 Interface with Ch1 Signal Output, MTB Sweep and MTB + DTB Gate Outputs *$825*

Options are not retrofittable. All required options must be included when order is placed.

The **n** indicates the required line cord. To select your line cord substitute the **n** by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

### Example, Ordering Configuration

To order a 200 MHz, full four channel Analog Oscilloscope with GPIB/IEEE-488 interface installed, and U.S. line cord, select:

| | **Model** |
|---|---|
| Basic Oscilloscope | PM 3094 |
| GPIB/IEEE-488 | /40n |
| US power cord (n=3) | /xx3 |
| Complete Model Number | PM 3094/403 |

### Accessories

### Passive Probes

**PM 9001/001** Modular 1:1 Probe, 1.5m (5 ft) Cable *$75*
**PM 9001/091** Modular 1:1 Probe, 1.5m (5 ft) Cable, Range Indicator and Command Button *$95*
**PM 9001/201** Modular 1:1 Probe, 2.5m (8 ft) Cable *$90*
**PM 9001/291** Modular 1:1 Probe, 2.5m (8 ft) Cable, Range Indicator and Command Button *$110*
**PM 9010/091** Modular 100 MHz 10:1 Probe, 1.5m (5 ft) Cable, Range Indicator and Command Button *$110*
**PM 9010/291** Modular 100 MHz 10:1 Probe, 2.5m (8 ft) Cable, Range Indicator and Command Button *$120*
**PM 9020/091** Modular 200 MHz 10:1 Probe, 1.5m (5 ft) Cable, Range Indicator and Command Button *$130*
**PM 9011/001** Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 100 MHz (in 10:1 mode), 10 MHz (in 1:1 mode) *$85*
**PM 9021/001** Switchable 1:1 or 10:1 Probe, 1.5m (5 ft) Cable, useful BW: 200 MHz (in 10:1 mode), 10 MHz (in 1:1 mode) *$115*
**PM 9100/001** Modular 200 MHz 100:1 Probe, 1.5m (5 ft) Cable *$155*
**PM 9100/091** Modular 200 MHz 100:1 Probe, 1.5m (5 ft) Cable, Range Indicator and Command Button *$180*
**PM 8918/301** Low-Pass filter probe, 4 kHz bandwidth *$124*
**PM 9002/001** General accessory set for PM 9000 series probes *$35*
**PM 9102/001** General accessory set for PM 9100 series probes *$40*
**PM 9003/001** Accessory extension set for PM 9000 series probes *$70*

### Active Probes

**PM 8940/09n** High Voltage Isolation Amplifier *$1120*
**PM 9355/09n** 70 MHz AC Current Probe *$1350*
**80i-110s** AC/DC Current Probe for Oscilloscopes *$395*

### Other Accessories

**PM 8902A/001** 12V DC Power Inverter *$320*
**PM 8903A/00n** Battery Pack, Charger, Inverter and Carrying Case *$680*
**PM 8914/001** CombiScope Serial Interface Cable *$50*
**PM 8917/00n** NTSC and PAL Video Sync Separator and Line Selector *$720*
**PM 8960/04** Retrofittable Rack Mount *$275*
**PM 8989/031** Traveller Carrying Case with Accessory Storage Compartments *$140*
**PM 8991/041** Oscilloscope Cart *$575*
**PM 8992/801** Accessory Pouch *$65*
**PM 9051/001** BNC male to 4 mm Banana Jack/Binding Posts *$27*
**PM 9381/001** Oscilloscope Camera System *$875*
**PM 2122/021** 50Ω Coaxial Switch *$970*
**PM 9074/001** 50Ω Coaxial Cable 1m (3 ft) *$27*
**PM 9585/011** 50Ω Feedthrough Termination, 1W *$60*
**80i-500s** AC Current Probe for Oscilloscopes *$170*
**80i-1000s** AC Current Probe for Oscilloscopes *$395*
**TC100** Instrument Cart *$540*

### Customer Support Services

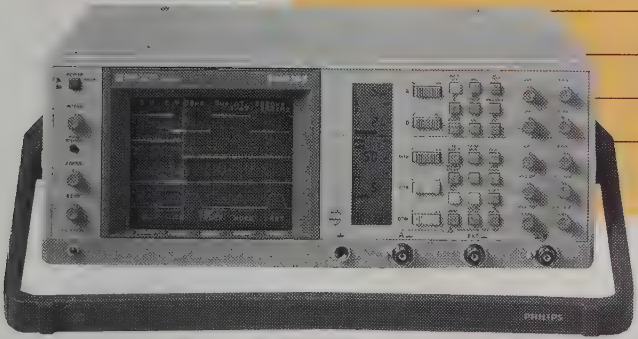
### Factory Warranty

Three-year product warranty. Five-year CRT warranty.

# Analog Oscilloscopes

## PM 3050/PM 3055 60 MHz & PM 3065/ PM 3070 100 MHz Analog Oscilloscopes

- AUTOSET for automatic amplitude, time, and trigger setting
- LCD panel displays status and settings
- 16 kV CRT acceleration voltage
- Fast action up/down controls and cold switching
- Single time base, dual time base and cursor versions
- High reliability: 3 year warranty, 5 year CRT warranty



PM 3070

### The 60/100 MHz Standards

The PM 3050 to PM 3070 series consists of four models which are all optionally available in rack mount versions for systems use. These are:

- PM 3050 60 MHz 2 channel, single time base
- PM 3055 60 MHz 2+1 channel, dual time base
- PM 3065 100 MHz 2+1 channel, dual time base
- PM 3070 100 MHz 2+1 channel, dual time base with smart cursors

Each unit represents a significant step forward in scope technology through their use of microcomputer control to both speed up and simplify the task of signal measurements.

Standard features in all models include AUTOSET for single pushbutton set up; a large backlit LCD showing all instrument settings; fast up/down rocker keys and cold switching for high reliability.

### Measurements In Seconds

Just press the green AUTOSET button and automatic setting of channel amplitude, time base sweep speed and triggering takes place, for any signal. If only one channel is connected only one channel is displayed but if both channels are being used then both are automatically scaled and displayed. Triggering takes place on the lower frequency channel to give a clear jitter free display. AUTOSET eliminates time consuming manual range finding and adjustment to give fast accurate results at the touch of one button.

### Clean and Simple Operation

With up/down rocker keys for amplitude and time base speed selection and push-buttons for display mode and trigger source selection the operation of this series of oscilloscopes is kept clean and simple. Upon each user action the backlit LCD display is immediately updated making at a glance review of the scopes current parameter settings possible rather than having to search the complete front panel to determine the operating conditions.

The internal microcomputer prevents illegal setups like incorrect main and delayed time base settings and clearly identifies on the display non-calibrated amplitude settings or grounded inputs. This avoids incorrect measurements, wasted time and frustration.

To speed up accurate measurements when using the delayed time base, the LCD gives a digital readout of the delay time, thus avoiding the need for any user calculations. For infrequent scope users the MENU key functions as a "help" key showing the facilities offered by each key on the scope and quickly acquainting the user with its operation.

### High Reliability and Easy Service

Behind the pushbutton operation all input signals are switched by hermatically sealed long life reed relays. These keep out damp and dirt from the active signal paths and ensure long life and long term measurement stability. In the unlikely event that a failure should occur the modular construction enables easy access to the suspect board without major disassembly.

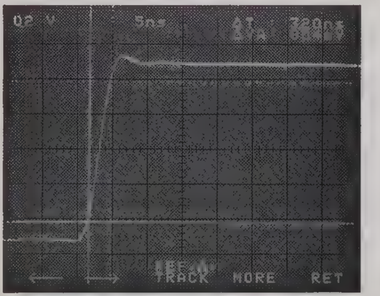
### Advanced CRT

With 16 kV acceleration and advanced electron optics the CRT display has exceptional brilliance combined with a small spot size making it ideal for measurements on high speed or low repetition rate signals. The effective screen area is a full 8 × 10 cm. An internally etched graticule is provided for accurate and parallax-free measurements. Graticule illumination is standard on all models.

### Clever Cursors

The PM 3070 offers full cursor measurement capabilities in both time and amplitude axes. Control of all cursor functions is by five keys in the bezel of the CRT which also are used to independently control the intensity of the alphanumerics and the cursors. Accurate measurements of peak to peak values, voltage ratios, rise times, phase relationships and time ratios are possible with direct numerical display on the CRT.

A special facility called the ZOOM function enables the signal between the cursors to be expanded to fill the full width of the screen by automatically adjusting the delay time and delay time base speed. This makes it easy to zoom in on a particular point of interest without having to consider how to set up the delay time section. In addition to the measured data both channel and time base status is displayed on screen and user text or messages can also be specified.



The four cursors of the PM 3070 enable accurate rise time measurements on fast pulses to be made quickly.

# Analog Oscilloscopes

## PM 3050/PM 3055 60 MHz & PM 3065/ PM 3070 100 MHz Analog Oscilloscopes

### PM 3050 60 MHz 2 Channels, Single Time Base

With all the standard facilities of the smart scope series this basic instrument provides comprehensive trigger facilities like TV line, TV frame, Auto Peak-Peak leveling and dc coupling in addition to trigger hold off. Time base speeds to 5 nsec per division are standard as well as x1 and x10 probe identification. X deflection via either channel is possible.

### PM 3055 60 MHz 2+1 Channels, Dual Time Base

The external trigger input of this scope doubles as a third input channel with a fixed attenuation. The Delayed Time Base (DTB) facility can be directly triggered from the main time base or from either input channel. Display of MTB intensified and DTB is possible at the same time or independently.

### PM 3065 100 MHz 2+1 Channels, Dual Time Base

Triggering to 150 MHz plus the high intensity CRT makes this unit the ideal general purpose workhorse.The fast 3.5 ns rise time and good pulse response characteristics make the PM 3065 the ultimate 100 MHz oscilloscope.

### PM 3070 100 MHz 2+1 Channels, Dual Time Base, Clever Cursors

The clever cursors provide both amplitude and time measurement capabilities. In the amplitude mode peak to peak, ratio and 10% and 90% levels (for rise times measurements) can be read directly from the display. In the time mode, rise times, ratio and phase measurements can be made and read from the display. In addition the ZOOM facility enables fast pinpointing and expansion of a specific section of the measured signal.

## Specifications

### Technical Specifications

**AUTOSET:** Autoset selects proper channel or channels, sets vertical deflection, time base speed and triggering for easy-to-read display of input signals.

### Vertical Deflection

**Display Modes:** Ch A, Ch B, -Ch B, Ch A + Ch B, Ch A - Ch B, X vs Y; Alternate or chopped

**Trigger View:** In any combination, chopped or alternate (not PM 3050)

### Frequency Response

**PM 3065/70:**
dc ... > 100 MHz at −3 dB
(20 mV/div ... 10 V/div);
dc ... >75 MHz at −3 dB
(2 mV/div ... 10 mV/div)

**PM 3050/55:**
dc ... >60 MHz at −3 dB
(20 mV/div ... 10 V/div);
dc ... >35 MHz at −3 dB
(2 mV/div ... 10 mV/div)

ac coupled: lower −3 dB point is <10 Hz

### Rise Time

**PM 3065/70:**
<3.5 ns (20 mV/div ... 10 V/div);
<4.9 ns (2 mV/div ... 10 mV/div)

**PM 3050/55:**
<6 ns (20 mV/div ... 10 V/div);
<10 ns (2 mV/div ... 10 mV/div)

**Deflection Coefficient:** 2 mV/div to 10 V/div (±3%) in steps of 1, 2, 5 sequence. Continuous control ratio between steps 1 to >2.5

**Input Impedance:** 1 MΩ ±2% // 20 pF ±2 pF

**Max. Rated Input Voltage:** 400V (dc + ac peak)

**Dynamic Range:** >24 div at 10 MHz

**CMRR:** 100:1 at 1 MHz

**Input:** BNC with automatic probe recognition

### Trigger View

### Frequency Response

**PM 3065/70:** DC to >100 MHz at −3 dB (via ext); dc to >75 MHz at −3 dB (Ch A or Ch B)

**PM 3050/55:** DC to >50 MHz at −3 dB (via ext, 0°C to 35°C); dc to >50 MHz at −3 dB (via Ch A or Ch B)

**Deflection Coefficient:** 100 mV/div via Ext Input, 2 mV/div to 10 V/div via Ch A or Ch B

### Horizontal Display Modes

**PM 3055/65/70:** MTB, MTBI, Alt TB, DTB, X-deflection (X vs Y)

**PM 3050:** Timebase or X-deflection (X vs Y)

### Main Time Base

**Time Coefficients:** 0.5 s/div to 50 ns/div (±3%) in steps of 1, 2, 5 sequence. Continuous control ratio between steps 1 to >2.5

**Magnifier:** x10, fastest sweep speed 5 ns/div. Error limit in x10: ±4%

**Hold-Off:** Continuously adjustable up to 10x minimum value

### Delayed Time Base (DTB) (not PM 3050)

**Time Coefficient:** 1 ms/div to 50 ns/div (±3%) in steps of 1, 2, 5 sequence

**Magnifier:** x10, fastest sweep speed 5 ns/div

**Error Limit Magnifier Sweep:** ±4%

**Trace Separation:** >±4 div DTB shift only

### Delay Time Base Multiplier (DTM) (not PM 3050)

**Resolution:** 1:10,000

**Error Limit Total:** 4% (in x10 magnifier)

**Delay Time Jitter:** 1 in >20,000

### Triggering (MTB or TB)

**Trigger Modes:** Auto (free run), normal (triggered), Single sweep

**Trigger Sources:** Ch A, Ch B Composite (Ch A/Ch B), Ext. (dc or ac), Line

**Trigger Coupling:** Auto Peak to peak (p-p), dc, TVL, TVF

### Triggering (DTB) (not PM 3050)

Starts or triggered by Ch A, Ch B, Composite (Ch A/Ch B), ext TVL (only if MTB TV selected)

### Trigger Sensitivity

| PM 3050 & PM 3055 | Internal | External |
|---|---|---|
| 10 MHz | 1.0 div | 100 mV |
| 50 MHz | 1.0 div | 150 mV |
| 100 MHz | 3.0 div | 500 mV |
| TVF/TVL | 0.7 div sync | 70 mV sync |
| Level Range | ±8 div | ±800 mV |

| PM 3065 & PM 3070 | Internal | External |
|---|---|---|
| 10 MHz | 1.0 div | 100 mV |
| 100 MHz | 1.2 div | 150 mV |
| 150 MHz | 2 div | 500 mV |
| TVL/TVF | 0.7 div sync | 70 mV sync |
| Level Range | ±8 div | ±800 mV |

Slope positive or negative; TVF or TVL positive or negative

### X-Deflection

**Deflection Coefficient:** Via Ch A or Ch B, 2 mV/div to 10 V/div; via ext input 100 mV/div

**Frequency Response:** DC to 2 MHz

**Error Limit:** ±5%

**Phase Shift:** <3° up to 100 kHz

### External Input

**Impedance:** 1 MΩ ±2% // 20 pF ±2 pF

**Maximum Input Voltage:** 400V (dc + ac peak)

### Cursor (PM 3070 only)

Intensity control independent of trace intensity

**Measurements:** V, t, 1/t, Ratio, Phase, Rise Time (4 way cursors), Zoom

**Settings:** User text, Settings readout.

### Output Options

Y Signal out from Channel A

**Deflection Coefficient:** 100 mV/div into 10 kΩ load

**Output impedance:** 75Ω

**Frequency Response**
**PM 3065/70:** >75 MHz at −3 dB
**PM 3050/55:** >60 MHz at −3 dB

**MTB Sweep Out:** Output voltage 0.5V/div; load 1 MΩ

**MTB Gate Out:** High when running MTB sweep; otherwise low; voltage output high >2.4V; low <0.4V

**DTB Gate Out:** High when running DTB sweep; otherwise low; voltage output high >2.4V; low <0.4V

# Analog Oscilloscopes

## PM 3050/PM 3055 60 MHz & PM 3065/ PM 3070 100 MHz Analog Oscilloscopes

### General Specifications

**Display:** CRT 8 × 10 cm viewing area, P31 phosphor, 16 kV acceleration voltage. Parallax-free graticule with continuously variable illumination. Separate constantly illuminated LCD for display of menus, settings, status indications, etc.

### Power Supply

Safety requirements meet following specifications: IEC 348 Class I, UL 1244, CSA Certified (CSA 556B), VDE 0411.

**Line Voltage:** 100V to 240V ±10% in one range

**Line Frequency:** 50 Hz to 400 Hz ±10% in one range

**DC Nominal Voltage:** 145V to 335V

**Power Consumption (AC Source):**

**PM 3050/55:** 50W

**PM 3065/70:** 60W

**Miscellaneous Calibration Output:** 1.2V ±1%

**Frequency:** 2 kHz typ.

**Z-modulation Input:** TTL-compatible, >2.0V blanks display; <0.8 max intensity, analog control possible between 2.0V and 0.8V

### Environmental Data

**Temperature Rated Range of Use:** +10°C to +40°C

**Limited Range of Operation:** 0°C to +50°C

**Storage:** −40°C to +75°C

**Altitude Operating:** 15,000 ft (4,500m)

**Non-Operating:** 40,000 ft (12,000m)

**Humidity:** 95% RH

**EMI:** Meets requirements of MIL-STD-461 Class B, VDE 0871 and VDE 0875 Grenzwert-klasse B

**Shock Operating and Non-Operating:** 30g, ½ sine wave, 11 ms duration, 6 shocks in each direction (3 each face), for a total of 18 shocks

**Vibration:** 5 Hz to 55 Hz, 15 minutes along each of three axes, with a maximum acceleration of 3g. Resonance dwell of 10 minutes at each frequency where resonance occurs, or at 33 Hz when no resonance found.

**Bench Handling:** MIL-STD-810, method 516, procedure V. The PM 3050/55/65/70 are designed to meet the requirements of MIL-T-28800 D, Type III, Class 5, Style D.

**CE:** Compliant as of January 1996

### Mechanical Data

**Width:** 387 mm (15.2 in) incl. handle; 350 mm (13.8 in) excl. handle

**Length** 518 mm (20.4 in) incl. handle; 456 mm (17.9 in) excl. handle; incl. knobs

**Height:** 146.5 mm (5.8 in) incl. feet; 134.5 mm (5.3 in) excl. feet

**Weight:** Approx 7.5 kg (16.5 lb) excl accessories.

## Ordering Information

### Models

**PM 3050** 60 MHz Analog Oscilloscope, single timebase ***$1590***

**PM 3055** 60 MHz Oscilloscope with dual timebase ***$1625***

**PM 3065** 100 MHz Oscilloscope with dual timebase ***$2250***

**PM 3070** 100 MHz Oscilloscope with dual timebase ***$2590***

These instruments are also available in rack mount configuration. To order increase selected type number by 2 (for instance PM 3057).

### Included with Instrument

Three-year product warranty, five-year CRT warranty; line cord; two 100 MHz 10:1 probes, model PM 8926/591 or equivalent, with 1.5m (5 ft) cable and scale factor readout; blue CRT contrast filter (on CRT); Operator and reference manual. Service manual is available upon return of reply card included with each instrument; and Certificate of Calibration Practices.

The **n** indicates the required line cord. To select your line cord substitute the **n** by:

1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

### Optional Configurations

When ordering, select basic "PM" model number, and add the configuration option number listed below as a suffix.

**/00n** Standard Version

**/11n** CRT with P7 Long Persistence Phosphor ***$100***

**/76n** Y Signal Output (limited to 75 MHz on 100 MHz models), plus MTB Gate + DTB Gate Outputs (on PM 3050 and PM 3052 MTB Gate only) ***$250***

**/77n** Y Signal Output (limited to 75 MHz on 100 MHz models), plus MTB Gate + DTB Gate Outputs (on PM 3050 and PM 3052 MTB Gate only) and CRT with P7 Long Persistence Phosphor ***$350***

Options are not retrofittable. All required options must be included when order is placed.

### Example, Ordering Configuration

To order a 100 MHz Oscilloscope with cursors in rack mountable configuration, with CRT option, and U.S. line cord select:

| | **Model** |
|---|---|
| Basic Oscilloscope | PM 3072 |
| P7 Phosphor | /11n |
| US power cord, n=3 | /xx3 |
| Complete Model Number | PM 3072/113 |

### Accessories

### Passive Probes

**PM 9001/001** Modular 1:1 Probe, 1.5m (5 ft) Cable ***$75***

**PM 8926/591** 100 MHz, 10:1 Probe; 1.5m (5 ft) Cable, with Range Indicator ***$85***

### Active Probes

**PM 8940/09n** High Voltage Isolation Amplifier ***$1120***

**PM 9355/09n** 70 MHz AC Current Probe ***$1350***

**80i-110s** AC/DC Current Probe for Oscilloscopes ***$395***

### Other Accessories

**PM 8902A/001** 12V DC Power Inverter ***$320***

**PM 8903A/00n** Battery Pack, Charger, Inverter and Carrying Case ***$680***

**PM 8917/00n** NTSC and PAL Video Sync Separator and Line Selector ***$720***

**PM 8969/001** Retrofittable Rackmount Kit ***$330***

**PM 8988/001** Protective Front Panel Cover ***$55***

**PM 8989/001** Traveller Carrying Case ***$175***

**PM 8989/031** Traveller Carrying Case with accessory storage compartments ***$140***

**PM 8991/041** Oscilloscope Cart ***$575***

**PM 8992/801** Accessory Pouch ***$65***

**PM 8998/001** Memory back-up for analog oscilloscopes ***$95***

**PM 9051/001** BNC male to 4 mm Banana Jack/Binding Posts ***$27***

**PM 9074/001** 50Ω coaxial cable 1m (3 ft) ***$27***

**PM 9075/001** 75Ω coaxial cable 1m (3 ft) ***$27***

**PM 9072/001** Coaxial cable 135Ω, BNC male to banana plugs, 1 m (3 ft) ***$65***

**PM 9585/011** 50Ω feedthrough termination, 1W ***$60***

**PM 9381/001** Oscilloscope Camera System ***$875***

**80i-500s** AC Current Probe for Oscilloscopes ***$170***

**80i-1000s** AC Current Probe for Oscilloscopes ***$395***

**TC100** Instrument Cart ***$540***

The **n** indicates the required line cord, see above.

### Customer Support Services

### Factory Warranty

Three-year product warranty. Five-year CRT warranty.

# Oscilloscope Accessories

## Compatibility Chart

Many oscilloscope accessories are available to enhance the performance of the instruments. The following pages give details on the wide range of accessories offered along with their performance characteristics.

**Accessory Compatibility Chart**

Use this list to see which oscilloscope accessories are compatible with the oscilloscopes listed on the right.

| | | PM 3370A | PM 3380A/82A/84A | PM 3390A/92A/94A | PM 3350A/55/65A/75 | PM 3331 | PM 3335 | PM 3082/84 | PM 3092/94 | PM 3050/3055/65/70 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Passive Probes** | | | | | | | | | | |
| PM 8926/591 | General purpose 10:1 probe | (1) | | | (1) | (1) | (1) | | | (1) |
| PM 9011/001 | Switchable 1:1 or 10:1 probe | ● | ● | | ● | ● | ● | ● | | ● |
| PM 9021/001 | Switchable 1:1 or 10:1 probe | ● | | ● | ● | ● | ● | | ● | ● |
| PM 9001/001 | Modular 1:1 probe | ● | | | ● | ● | ● | ● | ● | ● |
| PM 9001/091 | Modular 1:1 probe | ● | ● | ● | – | – | – | ● | ● | – |
| PM 9001/201 | Modular 1:1 probe | ● | | | ● | ● | ● | ● | ● | ● |
| PM 9001/291 | Modular 1:1 probe | ● | ● | ● | – | – | – | ● | ● | – |
| PM 9010/001 | Modular general purpose 10:1 probe | ● | ● | | ● | ● | ● | ● | | ● |
| PM 9010/091 | Modular general purpose 10:1 probe | ● | (1) | | ● | ● | ● | (1) | | ● |
| PM 9010/201 | Modular general purpose 10:1 probe | ● | ● | | ● | ● | ● | ● | | ● |
| PM 9010/291 | Modular general purpose 10:1 probe | ● | ● | | ● | ● | ● | ● | | ● |
| PM 9020/001 | Modular wide bandwidth probe | | | ● | | | | | ● | |
| PM 9020/091 | Modular wide bandwidth probe | | | (1) | | | | | (1) | |
| PM 9100/001 | High impedance 100:1 probe | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PM 9100/091 | High impedance 100:1 probe | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PM 8918/002 | Safety probes 10:1 (set of two) | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PM 8918/202 | Safety probes 10:1 (set of two) | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PM 8918/301 | Low-Pass Filter probe 4 kHz Bandwidth | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| **Passive Probe Accessory Sets** | | | | | | | | | | |
| PM 9002/001 | General accessory set for PM 90XX probes | | | | | | | | | |
| PM 9003/001 | Test lead and clip set for PM 90XX probes | | | | | | | | | |
| PM 9102/001 | General accessory set for PM 91XX probes | | | | | | | | | |
| **Active Probes** | | | | | | | | | | |
| PM 8940/09n | Isolation amplifier | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PM 9355/09n | Current probe | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PM 8917/00n | Video line selector | | | | ● | ● | ● | ● | ● | ● |
| 80i-110s | AC/DC current probe | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| 80i-500s | AC current probe | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| 80i-1000s | AC current probe | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| **Battery Packs and Power Converters** | | | | | | | | | | |
| PM 8902A/001 | 12V DC to AC power converter | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PM 8903A/00n | Battery power kit | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| **Accessory Pouches and Carry Cases** | | | | | | | | | | |
| PM 8992/801 | Full size pouch | ● | ● | ● | | | | ● | ● | ● |
| PM 8992/651 | Half size pouch | | | | ● | ● | ● | | | |
| PM 8989/001 | Traveller carry case | | | | ● | ● | ● | | | ● |
| PM 8989/031 | Traveller carry case | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| **Rack Mounts** | | | | | | | | | | |
| PM 8960/041 | Rack Mount kit | ● | ● | ● | | | | ● | ● | |
| PM 8969/001 | Rack Mount kit | | | | ● | ● | ● | | | ● |

● Means compatible and recommended
– Not compatible Power Option
(1) Supplied with instrument

# Oscilloscope Accessories

**Compatibility Chart** (continued)
**Accessory Compatibility Chart**
Use this list to see which oscilloscope accessories are compatible with the oscilloscopes listed on the right.

| | | PM 3370A | PM 3380A/82A/84A | PM 3390A/92A/94A | PM 3350A/55/65A/75 | PM 3331 | PM 3335 | PM 3082/84 | PM 3092/94 | PM 3050/3055/65/70 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Carts** | | | | | | | | | | |
| TC100 | Test Instrument Cart | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PM 8991/04 | Oscilloscope cart | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| **Camera** | | | | | | | | | | |
| PM 9381/001 | Camera kit for handheld use | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| **Adapters and Terminators** | | | | | | | | | | |
| PM 9051 | BNC (m) to Banana (f) | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PM 9053 | BNC (f) to Banana (m) | – | – | – | – | – | – | | – | – |
| PM 9061 | BNC (f) to BNC (f) | | | | | | | | | |
| PM 9067/001 | BNC T piece (m,m,f) | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PM 9585/001 | 50W 1Ω Terminator | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| **Coaxial Cables** | | | | | | | | | | |
| PM 9071 | Banana to Banana, 135Ω, 1m (3 ft) | | | | | | | | | |
| PM 9072 | BNC to Banana, 135Ω, 1m (3 ft) | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PM 9074 | BNC to BNC, 50Ω +B19, 1m (3 ft) | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PM 9075 | BNC to BNC, 75Ω, 1m (3 ft) | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| **Interface Cards, Cables and Adapters** | | | | | | | | | | |
| Y8021 | IEEE-488 cable, 1m (3.28 ft) | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Y8022 | IEEE-488 cable, 2m (6.56 ft) | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| Y8023 | IEEE-488 cable, 4m (13 ft) | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PM 8957A | Retrofittable IEEE-488 Interface | | | | | ● | ● | | | |
| PM 8958A | Retrofittable RS-232 Interface | | | | ● | | | | | |
| Y1709 | RS-232C printer cable, 2m (6.56 ft) male/female DB-25 to DB-25 | ● | | | ● | | | | | |
| PM 8914/001 | CombiScope™ Serial Interface cable DB-9f to DB-9f | | ● | ● | | | | | | |
| **Miscellaneous** | | | | | | | | | | |
| PM 8988 | Front cover | | | | | ● | | | | ● |
| PM 8998 | Memory backup | | | | | | | | | ● |
| **Software** | | | | | | | | | | |
| PM 2273 | AnyWave™ Software for DOS | ● | ● | ● | ● | ● | ● | | | |
| SW 33W | FlukeView™ voor CombiScopes™ Software for Windows | | ● | ● | | | | | | |

● Means compatible and recommended
– Not compatible Power Option
(1) Supplied with instrument

## Alternatives for Obsolete Probes

| Obsolete Probe | Current Alternative Probes |
|---|---|
| PM 8921 | PM 9001/001 |
| PM 8921L | PM 9001/201 |
| PM 9326, PM 8922/001, PM 8922/501 | PM 9011/001 |
| PM 9327, PM 9328, PM 9323 | PM 9011/001 |
| PM 9336, PM 8926/001, PM 8926/501 | PM 9010/001 |
| PM 8936/091, PM 8926/091 | PM 9010/091 |
| PM 8927 A, PM 8926/501 | PM 9010/001 |
| PM 8927 AL, PM 8926/201 | PM 9010/201 |
| PM 8927 AS | PM 9010/091 |
| PM 8928, PM 8926/501 | PM 9010/001 |
| PM 8932, PM 8931/001 | PM 9100/001 |
| PM 8933/091 | PM 9010/091 |
| PM 8935, PM 8929/001 | PM 9020/001 |
| PM 8935 L, PM 8929/201* | PM 9020/001 |
| PM 8926/291 | PM 9010/291 |
| PM 8931/091 | PM 9100/091 |

** PM 8929/201 cable length was 2.5m; PM 9020/001 has 1.5m cable.*

## Set of Accessories Supplied with General Purpose Probes

Ground lead with alligator clip
Mini rings
Indication rings
Insulation cap
DIL insulation cap
Spring loaded test clip
Ground needle
Spare probe tip
Manual

# Oscilloscope Accessories

## Passive Probe Specifications

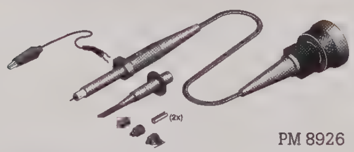
| Model | Attenuation Factor | Useful BW (MHz) | Impedance Ω/pF | Max Input Voltage (DC + AC Peak) | Compensating Range (pF) | Cable Length (m) (ft) | Auto Range Indication | Command Pushbutton |
|---|---|---|---|---|---|---|---|---|
| PM 8918/002 * | 10:1 | 100 | 10M//15 | 600V rms, 6 kV surge | 15 to 35 | 1.5 (5) | No | No |
| PM 8918/202 * | 10:1 | 75 | 10M//15 | 600V rms, 6 kV surge | 15 to 35 | 2.5 (8) | No | No |
| PM 8926/591 | 10:1 | 100 | 10M//14 | 500 | 15 to 35 | 1.5 (5) | Yes | No |
| PM 9011/001 | 1:1<br>10:1 | 7<br>100 | 1M//130<br>10M//14 | 42<br>500 | –<br>15 to 35 | 1.5 (5) | No | No |
| PM 9021/001 | 1:1<br>10:1 | 7<br>200 | 1M//130<br>10M//14 | 42<br>500 | –<br>15 to 35 | 1.5 (5) | No | No |
| PM 9001/001 | 1:1 | 15 | 1M//59 | 42 | – | 1.5 (5) | No | No |
| PM 9001/091 | 1:1 | 15 | 1M//59 | 42 | – | 1.5 (5) | Yes | Yes |
| PM 9001/201 | 1:1 | 12 | 1M//95 | 42 | – | 2.5 (8) | No | No |
| PM 9001/291 | 1:1 | 12 | 1M//95 | 42 | – | 2.5 (8) | Yes | Yes |
| PM 9010/001 | 10:1 | 100 | 10M//12 | 500 | 15 to 35 | 1.5 (5) | No | No |
| PM 9010/091 | 10:1 | 100 | 10M//12 | 500 | 15 to 35 | 1.5 (5) | Yes | Yes |
| PM 9010/201 | 10:1 | 100 | 10M//16.5 | 500 | 15 to 35 | 2.5 (8) | No | No |
| PM 9010/291 | 10:1 | 100 | 10M//16.5 | 500 | 15 to 35 | 2.5 (8) | Yes | Yes |
| PM 9020/001 | 10:1 | 200 | 10M//12 | 500 | 15 to 35 | 1.5 (5) | No | No |
| PM 9020/091 | 10:1 | 200 | 10M//12 | 500 | 15 to 35 | 1.5 (5) | Yes | Yes |
| PM 9100/001 | 100:1 | 200 | 20.2M//3.3 | 4000 | 15 to 35 | 1.5 (5) | No | No |
| PM 9100/091 | 100:1 | 200 | 20.2M//3.3 | 4000 | 15 to 35 | 1.5 (5) | Yes | Yes |

*The Command Pushbutton enables specific scope actions to be executed. The specific action is programmed by the user in the oscilloscope and may include such functions as AUTOSET, single shot or step to the next measurement setting. This function is implemented on the PM 3080 Series, PM 3090 Series, PM 3370 Series, PM 3380 Series and PM 3390 Series.*

** Set of 2 probes*

## Passive Probes

### 10:1 100 MHz Probes



PM 8926

**PM 8926/591** *$85*

Compact, economy class general purpose 10:1 probe, equipped with range indicator. Useful bandwidth 100 MHz. Cable length of 1.5m (5 ft). Probe is supplied with hook tip, retractable ground lead, 2 isolation caps, color coding rings and ground contact spring.

### Switchable Probes

PM 9011

**PM 9011/001** *$85*
**PM 9021/001** *$115*

General purpose, switchable 1:1/10:1 probes. The 1:1 transfer ratio allows for high sensitivity measurements at low frequencies (bandwidth 7 MHz). When switched to 10:1 transfer ratio, bandwidth is 200 MHz (PM 9021) or 100 MHz (PM 9011).

Each probe consists of:
Probe cable assembly
Probe body
Retractable hook tip
Ground lead and clip
Insulator sleeve
Spare probe tip
6 colored identification rings

### 1:1 Probes

PM 9001

**PM 9001/001** *$75*
**PM 9001/091** *$95*
**PM 9001/201** *$90*
**PM 9001/291** *$110*

Modular 1:1 probes for high sensitivity measurements at lower frequencies. Equipped with command switch and range indicator (/x91 only). Cable length 1.5m (5 ft) (PM 9001/0xx) or 2.5m (8 ft) (PM 9001/2xx).

Each probe consists of:
Probe cable assembly
Probe body
Retractable hook tip
Ground lead and clip
Insulator sleeve
Spare probe tip
6 colored identification rings

### 10:1 100 MHz and 200 MHz Probes

COMMAND SWITCH

PM 9010

**PM 9010/001** *$80*
**PM 9010/091** *$110*
**PM 9010/201** *$100*
**PM 9010/291** *$120*
**PM 9020/001** *$110*
**PM 9020/091** *$130*

Modular 10:1 probes for a wide range of applications. Useful bandwidth 100 MHz (PM 9010) or 200 MHz (PM 9020). Equipped with command switch and range indicator (/x91 only). Cable length of 1.5m (5 ft) (/0x1) or 2.5m (8 ft) (/2x1).

Each probe consists of:
Probe cable assembly
Probe body
Retractable hook tip
Ground lead and clip
Insulator sleeve
Spare probe tip
6 colored identification rings

# Oscilloscope Accessories

## 100:1 200 MHz Probes

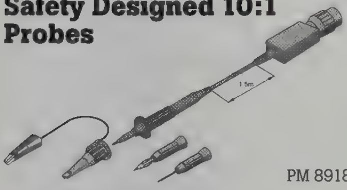
PM 9100

**PM 9100/001** *$155*
**PM 9100/091** *$180*

High voltage probes with a 100:1 transfer ratio. High input impedance (20.2 MΩ) and high isolation voltage of the tip allow measurements up to 4 kV. Equipped with command switch and range indicator (/091 only). Cable length 1.5m (5 ft).

Each probe consists of:
Probe cable assembly
Probe body
Retractable hook tip
Ground lead and clip
Insulator sleeve
Spare probe tip
6 colored identification rings

## Safety Designed 10:1 Probes



PM 8918

**PM 8918/002** *$176*
**PM 8918/202** *$202*

Set of two (one red, one grey) safety-designed 10:1 probes for oscilloscope use. The design is optimized for user's safety, double insulated according to IEC 1010-1. Maximum signal voltage is 600V rms, 6 kV surge. Overall length 1.5m (5 ft) (/002) or 2.5m (8 ft) (/202).

The probe set includes: slip-on ground leads, retractable hook tips with alligator ground clips, slip-on 2 mm test pins, probe tip to insulated banana adapter and screwdrivers for adjustment.

For these probes a wide range of adapters and grabbers are available, all based upon the same safety design (see ScopeMeter section of this catalog).

The **n** indicates the required line cord. To select your line cord substitute the **n** by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

## Probe Accessory Sets

General accessory sets, clip sets and test leads for use with probes of the PM 9xx-family.

PM 9002

**PM 9002/001** *$35*

Replacement set of accessories for PM 90xx 1:1 and 10:1 probes containing: retractable hook tip, ground lead with alligator clip, color coding rings (6), insulation caps (2), bayonet ground contact spring, PCB connector and spare probe tip.

PM 9003

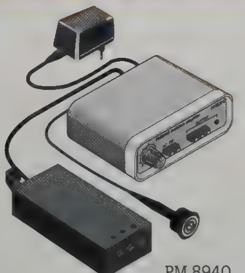
**PM 9003/001** *$70*

Accessory extension set for PM 90xx 10:1 and 1:1 probes, containing: dual test leads (2), short test leads (2), miniature grabber clips (2 red, 2 black), modular alligator clips (2) and modular ground leads long (2).

**PM 9102/001** *$40*

Replacement set of accessories for PM 9100 100:1 probes, containing: retractable hook tip, ground lead with alligator clip, color coding rings (6), insulation cap, spare probe tip. PM 9102 is included with all PM 9100 probes.

## Active Probes



PM 8940

### PM 8940/09n Isolation Amplifier *$1120*

The PM 8940/09n is an isolation amplifier which permits small signals which may be present on high common mode voltages to be safely measured with oscilloscopes or other types of measuring devices.

The transfer sensitivity can be as high as 5 mV/div, depending on the PM 8940's attenuator setting, at the same time isolating and suppressing common mode voltages of up to 650V ac rms.

Isolation is obtained through the use of optoisolation. The PM 8940/09n consists of two parts, permanently connected by a heat and chemical resistant cable.

The actual input is made entirely of plastic and is battery operated, and has screw-type input terminals. It is the user's responsibility to connect the input signals to the inputs in a safe manner. Battery life is approximately 4 hours.

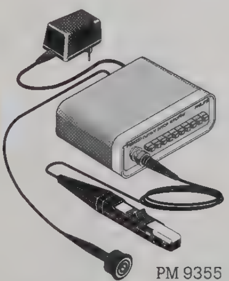
The "Control Box" provides controls for ac and dc coupling, as well as an input sensitivity switch and must be grounded to safety ground at all times.

Applications are in power electronics, SCRs, industrial electronics, utilities, transport companies, etc.

## Technical Specifications

### Frequency Response

**DC Coupled:** DC to 1.5 MHz (−3 dB)
**AC Coupled:** 3 Hz to 1.5 MHz (−3 dB)
**Deflection Coefficient:** 50 mV/div to 200V/div (HI), or 5 mV/div to 20V/div (LO)
**Dynamic Range:** 20 div at oscilloscope setting of 20 mV/div
**Diff. Input Impedance:** 10 MΩ//9 pF (HI); 1 MΩ//45 pF (LO)
**Maximum Diff. Input Voltage:** 650V rms
**Common Mode Rejection:** <= 0.5 div deflection with common mode of 650V rms, up to 60 Hz
**Power:** 115V ac or 220V ac (−10% to +20%), 45 Hz to 440 Hz, 10 VA



PM 9355

### PM 9355/09n AC Coupled Current Probe *$1350*

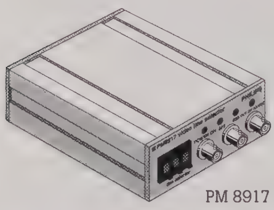
The PM 9355/09n provides a wide bandwidth and calibrated conversion from current signals to be measured into voltages to be accepted by an oscilloscope. It consists of a passive ac current sensing transformer, which plugs into an active amplifier/equalization circuit. The combination of these two guarantees a flat frequency response between 12 Hz and 70 MHz.

The amplifier section is equipped with its own sensitivity settings, calibrated in mA/div or A/div. To ensure proper calibration of the dimensions set on the PM 9355/09n, the oscilloscope input (with which it is used) must be set for a sensitivity of 20 mV/div.

With most Fluke oscilloscopes, this setting is automatically accomplished by the range indication on the BNC connector of the PM 9355/09n.

## Technical Specifications

**Maximum Wire Diameter:** 3 mm
**Frequency Response:** ±12 Hz to ±70 MHz at 5 mA/div to 1 A/div; ±12 Hz to ±45 MHz at 1 mA/div and 2 mA/div
**Sensitivity:** 1 mA/div to 1 A/div (10 ranges in a 1, 2, 5 sequence). Scope input set at 20 mV/div.
**Maximum Current:** 12A p-p (for frequencies over 300 Hz). Derated to 1A at 100 Hz or lower.
**Max Voltage on Conductor to be Measured:** 600V (dc + ac peak) with probe closed
**Dynamic Output Range:** −6 div or +6 div (at >300 Hz within the limits of max input current)
**Power:** 110 or 220V ac (−10% to +20%), 45 Hz to 440 Hz, 10 VA



PM 8917

### PM 8917/00n Video Line-Selector *$720*

Stand-alone signal processor used to separate the sync signal from a composite video signal of PAL or NTSC standard, to trigger an oscilloscope on any selected line.

Two BNC connectors are provided for feedthrough.

A third front panel mounted BNC is output of Line sync signal. Rear panel mounted BNC connectors provide TV Line sync and TV Frame or Field sync (switchable).

Selection of NTSC or PAL is automatic.

A thumb wheel switch permits selection of any video line to trigger a scope.

Limited availability

## Technical Specifications

**System:** CCIR/FCC 525 line or CCIR/EBU 625 line system. Selection is automatic, and indicated by LED.
**Input:** 0.7V to 3V composite video
**Impedance:** 1 MΩ//30 pF; 75Ω when terminated with 75Ω
**Maximum Input:** 50V (dc + ac peak)
**Outputs:** TV Frame (Vert sync) or TV Field, TV Line, selected TV Line
**Output Voltage:** 1V p-p into 75Ω

### Trigger Outputs

**Frame Pulse:** 0.5x frame width
**Field Pulse:** 1.8 µs
**Line Pulse:** 1.8 µs
**Selected Line Pulse:** 35 µs for line 0; 64 µs for all other lines
**Power:** 90V to 264V ac in one range, 45 Hz to 66 Hz, 7W

The **n** indicates the required line cord. To select your line cord substitute the **n** by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

80i-1000s

### 80i-1000s *$395*

**Clamp-on AC Current Probe 1 mA to 1000A for Scopes**

AC Current clamp for measurements on power systems for power quality measurements and distribution system troubleshooting. The probe is compatible with oscilloscope inputs and provides a millivolt output signal to allow an oscilloscope to accurately reproduce current waveforms with minimal distortion.

Double and reinforced insulation throughout protects the user from working voltages of up to 600V rms. The jaw size allows measurements on large power cable assemblies as well as on individual wires. The 100 kHz low pass output filter eliminates wideband noise.

**Usable freq. range (with current derating):** 5 Hz..100 kHz
**Required instrument input impedance:** > 1 MΩ // ≤ 47 pF
**Maximum Conductor Size:** 54 mm (2.13″)
**Electrical safety:** Designed to protection Class II, double or reinforced insulation requirements of UL 1244, ANSI/ISA S82, CSA C22.2 No.231 and IEC 1010-1.
**Working Voltage:** Clamp jaws to ground 600V rms on Overvoltage Category III circuits.
**Float Voltage:** Output cable and connector to ground circuits 600V rms on Overvoltage Category III

80i-110s

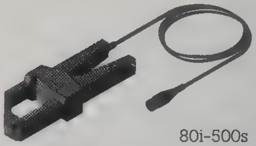
### 80i-110s *$395*

**Clamp-on AC/DC Current Probe 50 mA to 100A for Scopes**

Accurate AC, DC, and AC+DC current measurements for electrical and electronic applications. Wide measurement range from 50 mA to 100A - useful to 10 mA.

The 80i-110s has a safety designed 600V insulated BNC, compatible with Fluke's Oscilloscopes, and ScopeMeter test tools.

**2 switch selectable input ranges:** 0..10A, 0..100A
**Basic accuracy:** < ± 3% of reading + 50 mA
**Output signal:** 100 mV/A, 10 mV/A
**Frequency range:** DC.. 100 kHz
**Working Voltage:** 600V AC rms
**Maximum conductor size:** 11.8 mm (0.5″) diameter
**Safety rating:** IEC 1010 installation per category II @ 600V and UL 1244 and CSA-C22.2 no. 1010.1



80i-500s

### 80i-500s *$170*

**Clamp-on AC Current Probe 1A to 500A for Scopes**

Current clamp for capturing current waveforms with Fluke Oscilloscopes, ScopeMeter test tools, and other voltage-input devices, without breaking the circuit. Designed for industrial and commercial power distribution systems.

Enhanced safety by using double or reinforced insulation for probe jaws, handle, output cable and BNC connector (rated to 600V AC rms).

**Input current range:** 1A to 500A AC rms
**Basic accuracy:** ± 3% of reading
**Output signal:** 1 mV AC per 1A AC, 1000:1 division ratio

| Output Scaling | 1 mV/A | 10 mV/A | 100 mV/A |
|---|---|---|---|
| Input current (A) | 5..1000A<br>(2000 peak) | 0.5..100A<br>(200A peak) | 0.1..10A<br>(20A peak) |
| Accuracy | 2% of reading | 2% of reading | 3% of reading ± 100 mA |

# Oscilloscope Accessories

**Frequency range:** 5 Hz to 10 kHz
**Working Voltage:** 600V AC rms
**Maximum conductor size:** 30 mm ( 1.18") diameter
**Safety rating:** IEC 1010-1 installation per category III @ 600 Volts

## Battery Packs and Power Converters

PM 8902A

### PM 8902A/001 DC to AC Converter* *$320*

The PM 8902A provides the capability to run any of the Fluke oscilloscopes from a 12V dc supply.

This highly compact and highly efficient converter has a 115V ac output which directly plugs into the power input connector at the rear of the oscilloscope.

*Limited Availability

### Technical Specifications

**Input Voltage:** 10V dc to 15V dc
**Low Battery Alarm:** Audible alarm at ±10.7V dc
**Maximum Current Drawn:** 10A at output power of 100W
**No Load Current Drawn:** 70 mA
**Output Voltage:** 115V ac (rms), modified sine wave
**Voltage Regulation:** ±10% (for 11V dc to 14V dc input)
**Output Frequency:** 60 Hz ±0.1%
**Maximum Continuous Output:** 100W at -20°C to +50°C, 125W at -20°C to +40°C
**Maximum Short Term Output:** 400W surge 200W for 5 minutes maximum
**Overload Protection:** Electronic shut down at 70°C, restart at 65°C
**Dimensions:** 38 mm H × 115 mm W × 115 mm D (1.5 in H × 4.6 in W × 4.6 in D)
**Connection to DC Source:** Cigarette lighter plug
**Supplied with Unit:** 2m (6 ft) cigarette lighter extension cable and instruction manual

PM 8903

### PM 8903/00n *$620*

**Battery Pack, Charger, Power Converter & Carrying Case**

The PM 8903/00n gives Fluke oscilloscopes battery powered operation independent of any other power source. This complete set consists of the PM 8902A/001 dc to ac converter with a mounting strap to attach it to any Fluke oscilloscope, a 12V 15 Ah battery, battery charger, and carry case with shoulder strap.

**Dimensions:** 20 cm H x 30 cm W x 17 cm D ( 7.9" H x 11.8" W x 6.7" D)
**Weight:** 10.2 kg (22.5 lbs)
**Charging Unit $V_{in}$:** 115/230V ac, 50 Hz to 60 Hz

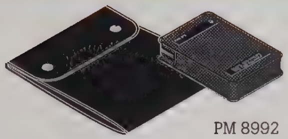
### Typical Operating Times

| **Analog** | | **CombiScope™** | |
|---|---|---|---|
| PM 3050 | 90 min. | PM 3331 | 75 min. |
| PM 3055 | 90 min. | PM 3335 | 75 min. |
| PM 3065 | 75 min. | PM 3350A | 60 min. |
| PM 3070 | 75 min. | PM 3365A | 55 min. |
| PM 3092 | 65 min. | PM 3355 | 50 min. |
| PM 3094 | 65 min. | PM 3375 | 40 min. |
| | | PM 3370A | 40 min. |
| | | PM 3380A | 40 min. |
| | | PM 3382A | 40 min. |
| | | PM 3384A | 40 min. |
| | | PM 3390A | 40 min. |
| | | PM 3392A | 40 min. |
| | | PM 3394A | 40 min. |

The **n** indicates the required line cord. To select your line cord substitute the **n** by:

1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

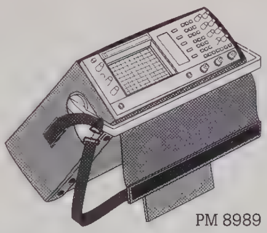
## Accessory Pouches and Carry Cases



PM 8992

### PM 8992/801 Full Size Pouch *$65*
### PM 8992/651 Half Size Pouch *$55*

Adds storage space to portable oscilloscope models for most frequently used accessories when the oscilloscope is used in portable, or field service applications.



PM 8989

### PM 8989/001 Traveller Carry Case *$175*

**For PM 3050, PM 3055, PM 3065, PM 3070, PM 3335, PM 3350A, PM 3355, PM 3365A, PM 3375**

This rugged carry case provides protection of the oscilloscope during transport as well as during operation and provides storage for probes and manual. The integral shoulder strap enables the oscilloscope to be easily carried from location to location.

The oscilloscope can be used without removing it from the carry case and a tilt stand gives an ideal viewing angle when the oscilloscope must stand on the floor.

### PM 8989A/031 Traveller Carry Case *$140*

**For PM 308x, PM 309x, PM 3370A, PM 338x, PM 339x**

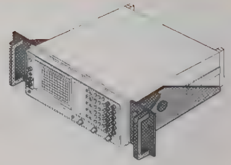
This rugged carry case provides protection for the oscilloscope and its accessories during transportation in inclement weather.

Ample space is provided for accessories and manuals.

The case has convenient straps for hand carry, a shoulder strap and an additional strap to carry it as a "ruck sack".

# Oscilloscope Accessories

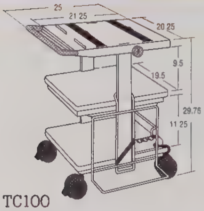
## Rackmounts



### Rack Mount Kits

| Oscilloscope Typenumber | Rack Mount Typenumber | Dimensions | | | | | | | Price |
|---|---|---|---|---|---|---|---|---|---|
| | | Height | | | Length | | Width | | |
| | | Height | E | mm | in | Length | mm | in | |
| PM 3050/55/65/70 | PM 8969/001 | 3E | 133.4 | 5.25 | 392 | 15 | 483 | 19 | *330* |
| PM 3082/84/92/94 | PM 8960/041 | 4E | 177.8 | 7 | 481 | 19 | 483 | 19 | *275* |
| PM 3331/35/50A/55/65A/75 | PM 8969/001 | 3E | 133.4 | 5.25 | 392 | 15 | 483 | 19 | *330* |
| PM 3370A/80A/82A/84A/90A/92A/94A | PM 8960/041 | 4E | 177.8 | 7 | 481 | 19 | 483 | 19 | *275* |

## Carts

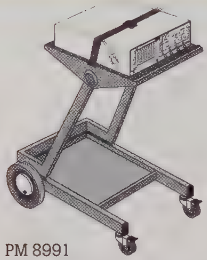


TC100

### TC100 Instrument Transport Cart *$540*

The TC100 Instrument Cart provides three levels of work surface, each of which accommodates instruments up to 19″ wide. It easily combines an oscilloscope or other instrument, with a printer and paper supply on one easily movable work station. The top shelf can be adjusted over an angle of 25°, and it has a safety lock. The cart has a capacity of 300 lb. Four casters, two of which can be locked, provide excellent mobility, and maneuverability. Options include a line power strip, accessories drawer, and a CPU bracket.

**Drawer Size:** 17.75″ W × 19.5″ D × 3″ H
**CPU Bracket Size:** 15″ W × 5.5′ D × 17″ H



PM 8991

### PM 8991/04 Oscilloscope Cart *$575*

The PM 8991 provides oscilloscope support next to the lab table, and an easy way to move oscilloscopes around in labs, or factory floors.

With a large footprint for stability, and large wheels with roller bearings for smooth operation, easy movement over thresholds, cables etc. is realized. The front wheels have casters for maneuverability. The angle of the table is continuously adjustable between 15° downward to +70° upwards and once set is securely locked.

## Camera

PM 9381

### PM 9381 Polaroid® Camera *$875*

Camera system for instant photographic recording of oscillograms. It can be used as a handheld camera, or used with spacer body and oscilloscope bezel for fixed installation and longer exposure times.

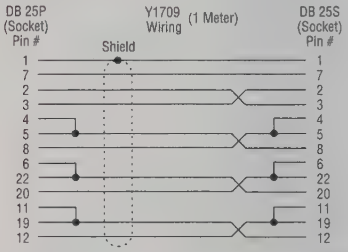
### Camera Specifications

**Object to Image Ratio:** 1: 0.85
**Lens:** 70 mm f/3.5
**Shutter:** Self-cocking, mechanical, 1 s to 1/125s and B; sync contact for event triggering
**Film Back:** Fixed, suitable for Polaroid type 107
**Adapters Supplied:** Handheld type and PM 8978/011

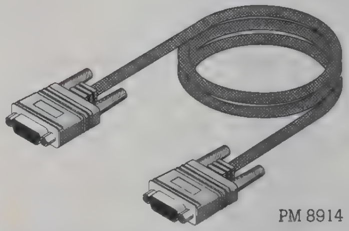
## Cables

### Y1709 RS-232C Serial Printer Cable *$180*

Printer cable to make an RS-232 connection between an oscilloscope and a printer. Connectors are DB-25, one male and one female. Cable length 1m (2.5 ft).



Y1709



PM 8914

### PM 8914/001 CombiScope Interface Cable *$50*

The PM 8914/001 CombiScope Interface Cable provides the RS-232 connection between a CombiScope and a PC. It is equipped with DB-9 female connectors on either side, fitting directly onto most PC serial busses. Cable length is 1.5m (5 ft). Cable wiring diagram is based upon the RfR protocol, providing a full seven wire connection and supporting hardware handshake.

# Software

## FlukeView™ CombiScope™ Software for Windows®

Capture complete screen images or waveforms

Store the captured screen images or waveforms in popular PC file format for later retrieval

Use screen images in your documents for documenting measurements

Use waveform data in spreadsheet programs for detailed analysis or graphical output

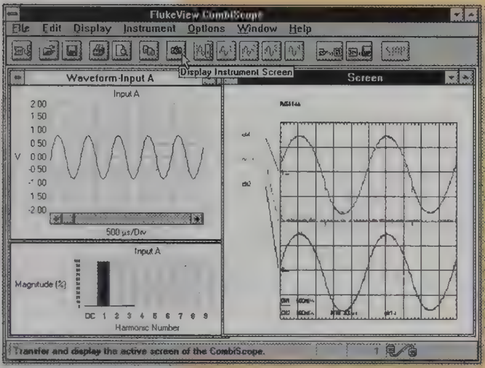
Analyze harmonics of a waveform, determine the spectrum using FFT analysis

Compare acquired waveforms with stored waveforms

Save and retrieve set-ups

On line context sensitive help always available

Communication parameters setup



Transfer and display the active screen of the CombiScope.

## Add PC power to Fluke Autoranging CombiScopes

FlukeView CombiScope software documents measurements the easy way. A simple way to open up a host of valuable new functions.

### Documenting

Capture waveforms from the CombiScope screen or memory to your PC.

If you wish, you can printout complete screens directly. Or store graphical data in a popular file format and import into your favorite word processor or spreadsheet.

### Archiving

Waveform storage and retrieval with text annotations like measurements conditions and instrument set-ups. Create your own library of waveforms. Ideal for reference and comparison purpose.

### Analysis

Get valuable extra measurements data; and reveal relationships and conditions that could otherwise remain hidden.

### Before Measurements

Before you start your measurements you can download complete measurement set-ups from PC to your CombiScope for fast preparation of various measurement sequences.

### During Measurements

While making acquisitions, you can compare them with known good reference waveforms stored on disk.

### After Measurements

After measurements you can generate fast hardcopy outputs. Just transfer CombiScope screen images to the PC and make a printout using the PC printer.

Or for reporting, you can store CombiScope screen images in a popular file format, then import them into your word processor or spreadsheet program.

For detailed signal examination, you can analyze, process and compare waveforms with those stored in your PC to find fault conditions.

Waveform archiving is simple and efficient, using standard Windows file menus.

### System Requirements

### FlukeView CombiScope for Windows

IBM PC or compatible with 386 or higher
Windows 3.1 or higher
All graphics adapters, printers and input devices as supported by Windows
One free RS-232 port

## Ordering Information

### Models

**SW33W/011E** FlukeView CombiScope for Windows, English Manual *$295*

**SW33W/011F** FlukeView CombiScope for Windows, French Manual *$295*

**SW33W/011G** FlukeView CombiScope for Windows, German Manual *$295*

**SW33W/911E** FlukeView CombiScope for Windows, Multicopy English version *$175*

**SW33W/911F** FlukeView CombiScope for Windows, Multicopy French version *$175*

**SW33W/911G** FlukeView CombiScope for Windows, Multicopy German version *$175*

### Accessories for SW33W

**PM8914/001** CombiScope™ Serial Interface Cable, RS 40 DB-25 to DB-9(f) DB-9(f) to DB-9(f) *$50*

Windows and Microsoft are registered trademarks of Microsoft Corp.
FlukeView and CombiScope are trademarks of Fluke Corp.

## Feature List

| | |
|---|---|
| Supported CombiScopes | PM 3394A, PM 3394, PM 3392A, PM 3392, PM 3390A, PM 3384A, PM 3384, PM 3382A, PM 3382, PM 3384E, PM 3380A, PM 3370A. |
| Interface | RS-232 1200...19200 baud |
| Operating system | Windows® |
| Language | English |
| User manual | English, German or French |
| Installation | Setup program |
| Receive image | CombiScope screen plot |
| Open and save image format | HPGL, BMP, PCX |
| Print | Image, waveform |
| Colors | Selectable |
| Sizing | Flexible |
| Reading | Single and continuous |
| Description text | With waveform and image |
| Copy to clipboard | Image and waveform data |
| Receive waveforms | Input and memory waveforms |
| Open and save waveform format | ASCII (.CSV); Binary (.CUR) |
| Analysis | Spectrum, harmonics |
| Setup | Save to file, retrieve from file |
| Interactive control | AutoSet, Arm Trigger, Recall set-up, Save set-up, Default set-up |

## PM 2273 AnyWave™ Software for DOS

Capture and store screens, images or waveforms

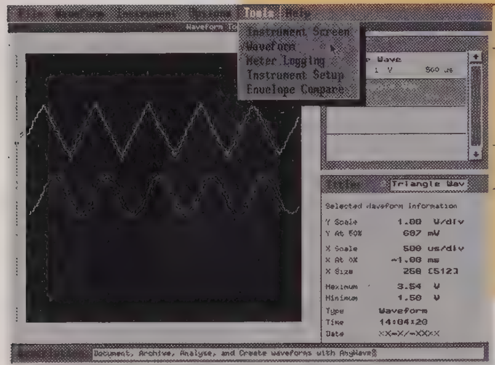
Filter, smooth, add, subtract and multiply waveforms

Sketch waveforms free hand or point to point

Interactive control of ScopeMeter or CombiScope attenuation, timebase, coupling, meter functions and triggering

On line context sensitive help always available

Modem communication support



```
Selected Waveform Information
Y Scale       1.00  V/div
Y At 50%       687  mV
X Scale        500  us/div
X At 0%      -1.00  ms
X Size         250  [512]
Maximum       3.54  V
Minimum       1.50  V
Type       Waveform
Time       14:04:20
Date       XX-X/-XXXX
```

Document, Archive, Analyse, and Create waveforms with AnyWave®

PM 2273

### Add PC Power to your ScopeMeter®, CombiScope™ or Arbitrary Waveform Generator

AnyWave Software documents measurements the easy way. A simple way to manage and process your measurement data and results, with an intuitive mouse driven graphic user interface.

### Document

Capture waveforms and measurement data on the PC. Print out complete instrument screens directly, or store graphical data in a popular file format and import into your favorite word processor or spreadsheet.

### Archive

Waveform storage and retrieval with text annotations like measurement conditions and instrument set-ups. Ideal for creating your own library of waveforms, screen images and setups for reference and comparison purposes. Database management functions allow files to be saved and retrieved with keywords.

### Analyze

Get valuable extra measurement data, reveal relationships and conditions that could otherwise remain hidden. You can also log ScopeMeter meter reading to monitor and analyze slowly changing signals and related events.

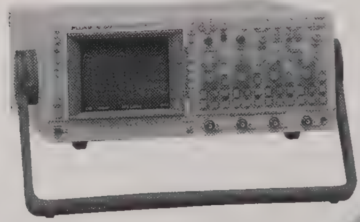
### Waveform creation for Fluke Arbitrary Waveform Generators

Create and edit waveforms and signal envelopes quickly and conveniently. Starting from scratch, waveforms can simply be drawn or edited on your PC screen with the mouse, using a selection of freehand and linedraw modes and drawing tools. Use real-life waveforms captured from your CombiScope or ScopeMeter test tool, then edit as required to meet specific test needs. The zoom facility offers increased resolution when dealing with small parts of a waveform, for detailed viewing and editing.

Extended waveform sequences can be created by using test sequence option. The sequences can be transferred to a Fluke arbitrary waveform generator with optional sequence generator.

### Test Envelope Creation

Easy creation of test envelopes (or templates) defined by upper and lower limit waveforms. These envelopes serve as a reference for other waveforms captured by your CombiScope or ScopeMeter test tool, enabling instant, automatic pass/fail testing. A clear pass/fail indication is given on-screen, and failing waveforms can be transferred automatically to the PC for analysis or archiving. Test envelopes can be created simply by editing captured signals or by freehand drawing.



### Supported Instruments

ScopeMeter: 97, 99, 105 (RS 232)
ScopeMeter: 91, 92, 96 Screen Capture only (RS-232)
4 channel CombiScope: PM 3382, PM 3384, PM 3392, PM 3394, (GPIB & RS-232), PM 3384 (RS-232)
Autoranging 4 channel: CombiScope PM 3382A, PM 3384A, PM 3392A, PM 3394A, (GPIB & RS-232)
Autoranging 2 channel: CombiScope PM 3370A, PM 3380A, PM 3390A, (GPIB & RS-232)
2 channel CombiScope: PM 3331/80 (RS-232), PM 3335, PM 3350, PM 3350A, PM 3355, PM 3365, PM 3365A, PM 3375, (GPIB & RS-232)
Arbitrary waveform generator: PM 5138, PM 5138A, PM 5139, PM 5150 (GPIB & RS-232)

### System Requirements

IBM PC/AT or compatible
EGA or VGA graphics adapter
MSDOS® 3.3 or later, Min. 450 KB free memory
Microsoft® Mouse or compatible
Supports over 100 printers
One free RS-232 port or GPIB interface PM 2201/03

## Ordering Information

### Models

**PM 2273/002** AnyWave 2.0 for DOS ***$295***

**PM 2273/502** AnyWave 2.0 for DOS upgrade version (for AnyWave 1.0 or 1.1) ***$125***

**PM 2273/902** AnyWave 2.0 for DOS multicopy version ***$175***

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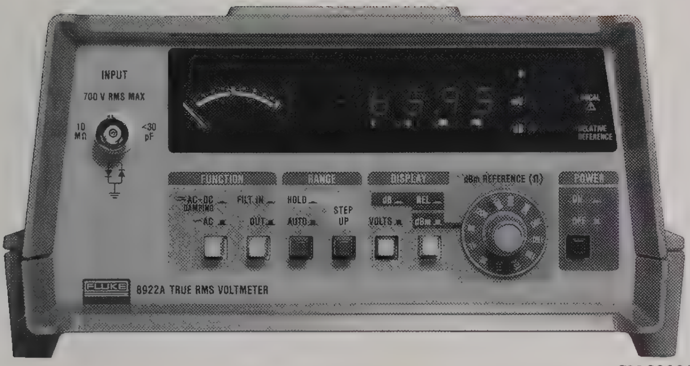
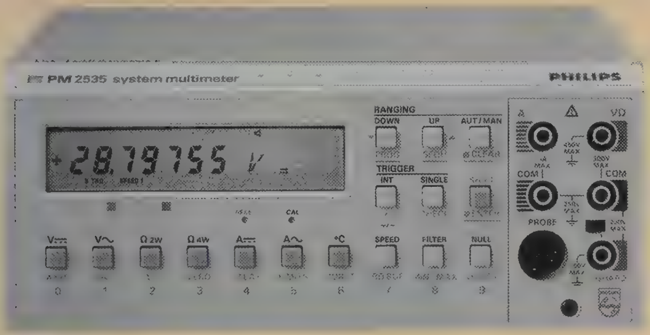
AnyWave, CombiScope and FlukeView are trademarks, and ScopeMeter is a registered trademark of Fluke Corp.

# Bench/System Multimeters


INPUT
700 V RMS MAX
10 MΩ
<30 pF
FUNCTION
RANGE
DISPLAY
dBm REFERENCE (Ω)
POWER
AC+DC DAMPING
AC
FILT IN
OUT
HOLD
AUTO
STEP UP
VOLTS
dB
REL
dBm
ON
OFF
RELATIVE REFERENCE
FLUKE 8922A TRUE RMS VOLTMETER

PM 8922A


PM 2535 system multimeter
PHILIPS
+28.79755 V
RANGING
DOWN
UP
AUT/MAN
TRIGGER
INT
SINGLE
SPEED
FILTER
NULL
V⎓
V~
Ω 2W
Ω 4W
A⎓
A~
°C
0
1
2
3
4
5
6
7
8
9
COM
PROBE

PM 2535

FLUKE 8842A MULTIMETER
+188888
INPUT
SENSE
V DC
V AC
kΩ 2 WIRE
kΩ 4 WIRE
mA
mA
AUTO
TRIG
EX TRIG
RATE
OFFSET
LOCAL
SRQ
CALIBRATION SEAL

8842A

This category of digital multimeters (DMMs) features all the Fluke bench and system meter line. Included are high speed instruments for use in automated test and measurement systems, and more compact, inexpensive models for less demanding jobs on the workbench or, with battery or battery pack, in the field.

Fluke bench/system multimeters are available with 3½ to 7½ digits of resolution and a variety of accuracy levels. All system meters are available with either GPIB/IEEE-488 or RS-232C interfaces which allow easy system integration.

Fluke meets today's increasing need for automation in test & measurement by offering one of the widest ranges of GPIB-controlled instruments, switching and I/O units, GPIB controllers, software tools and experienced customer support services.

A wide range of instrumentation makes it easy for the user in R&D, manufacturing, service and education to select the required building blocks for his application from one supplier.

Fluke anticipates the requirements of users in R&D, manufacturing and education by offering an industrial GPIB controller for applications in manufacturing and process control. We also offer GPIB interface cards and PC software for applications that require flexibility and access to a wide range of software tools.

## Contents

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**Digital Voltmeters**
Page 55
**Handheld Multimeter**
Page 58
**GPIB Switching System**
Page 62

# System & Bench Multimeters

## Selection Guide

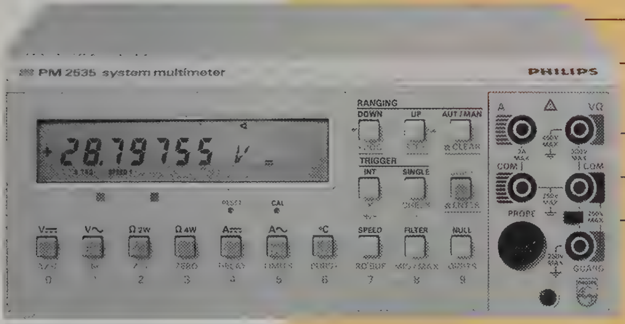
| | | DCV | | | Resistance | | | ACV | | | | | Other Features | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Digits | Acc. % | Res. µV | Max V | Acc. % | Res. mΩ | Max MΩ | TRMS | Acc. % | Res. µV | Max V | Freq Hz | Speed rds/sec | IEEE -488 | RS -232 | Offset/ Rela- tive | dB or dBm | Ratio | Burst Mem | Int. Batt. | Page No. |
| **Digital Multimeters** | | | | | | | | | | | | | | | | | | | | | |
| PM 2534 | 6½ | 0.0050 | 0.1 | 300 | 0.020 | 1 | 300 | ● | 0.040 | 10 | 300 | 100k | 100 | ● | Δ | | | | ● | | 43 |
| PM 2535 | 6½ | 0.0050 | 0.1 | 300 | 0.020 | 1 | 300 | ● | 0.040 | 10 | 300 | 100k | 100 | ● | Δ | | ● | | ● | | 43 |
| 8842A | 5½ | 0.0025 | 0.1 | 1000 | 0.005 | 0.10 | 20 | Δ | 0.070 | 1 | 700 | 100k | 100 | Δ | | ● | | | | | 46 |
| 8840A | 5½ | 0.0040 | 1 | 1000 | 0.010 | 1 | 20 | Δ | 0.140 | 1 | 700 | 100k | 100 | Δ | | ● | | | | | 46 |
| PM 2525 | 5½ | 0.0200 | 1 | 1000 | 0.100 | 10 | 200 | ● | 0.200 | 10 | 750 | 100k | 10 | Δ | Δ | ● | ● | | | Δ | 51 |
| **Wideband True-RMS AC Digital Voltmeters** | | | | | | | | | | | | | | | | | | | | | |
| 8920A | 3½ | | | | | | | ● | 0.500 | 1 | 700 | 20M | 2.5 | Δ | | ● | ● | | | | 55 |
| 8921A | 3½ | | | | | | | ● | 0.500 | 1 | 700 | 20M | 2.5 | Δ | | ● | ● | | | | 55 |
| 8922A | 3½ | | | | | | | ● | 0.500 | 1 | 700 | 11M | 2.5 | Δ | | ● | ● | | | | 55 |
| **Scanning Multimeters** | | | | | | | | | | | | | | | | | | | | | |
| 2620A | 5 | 0.0210 | 10 | 300 | 0.05 | 10 | 10 | ● | 0.2 | 10 | 300 | 100k | 17 | Δ | ● | ● | | | ● | ● | 113 |
| 2625A | 5 | 0.0210 | 10 | 300 | 0.05 | 10 | 10 | ● | 0.2 | 10 | 300 | 100k | 17 | | ● | ● | | | ● | ● | 113 |

●Standard
ΔOptional

# System/Bench Multimeters

## PM 2534 & PM 2535 System Multimeters

- 3½ to 6½ digits
- 100 nV resolution
- 100 measurements/second
- GPIB/IEEE-488 interface standard, RS-232C optional
- Front or rear input
- Scanner extension
- Data calculation, collection and control (PM 2535)



PM 2535

The PM 2534 and PM 2535 Systems Multimeters cover a broad range of applications. While both are suitable for a wide range of general purpose measurements, the PM 2535 offers additional functions for applications demanding data gathering, and fast measurement collecting and processing.

### Basic Features

Both the PM 2534 and PM 2535 offer seven measurement functions, front or rear inputs, and 6½ digit guarded sensitive measurements or up to 3½ digit high speed measurements. The units can operate in scan mode under external control via the standard GPIB/IEEE-488* interface.

### Extra Capabilities of the PM 2535

As well as the above features, the PM 2535 has built-in data collection, control facilities and calculations including Ax + B, Δ%, dBm and relative measurements. Maximum and minimum values can be stored over a time interval, and warnings can be given if specified limits are exceeded. Burst mode provides up to 150 measurements/sec. Sequence programming allows repetition of the same measurement cycle.

### Fast Measurement and Output

At a touch of the 'speed' button, the PM 2534 and PM 2535 step through 6½, 5½, 4½, and 3½ digit modes, enabling the optimum speed/resolution combination to be selected for every application. At a 3½ digit resolution the instrument makes 100 measurements per second and can transmit the measured values through its standard GPIB interface at the same rate.

### VDC Measurement Speed

(Incl Controller)

| Digits | Trigger Mode | Measurements/s |
|---|---|---|
| 3½ | Internal | 100 |
| 3½ | IEEE-488 | 50 |
| 4½ | IEEE-488 | 30 |
| 5½ | IEEE-488 | 3 |
| 6½ | IEEE-488 | 0.3 |

### Measurement Capabilities

The performance of these instruments cover more than dc voltages alone. In fact, seven measuring functions, including temperature are standard.

### Typical measurement speeds

| Function | Maximum Resolution | Maximum Range | Accuracy (90-Day) |
|---|---|---|---|
| V dc | 100 nV | 300V | 0.005% |
| V ac | 10 μV | 300V | 0.2% |
| I dc | 100 nA | 3A | 0.03% |
| I ac | 10 μA | 3A | 0.2% |
| Ω 2-wire | 1 mΩ | 300 MΩ | 0.02% |
| Ω 4-wire | 1 mΩ | 3 MΩ | 0.02% |
| °C via Pt-100 | 0.1°C | −100°C to +850°C | 0.3% |

### Operator and Application Friendly

Single button selection of function, range and trigger modes make the PM 2534 and PM 2535 very simple to use. Precise measurements are always made very quickly thanks to the 'NULL' button to compensate for small offsets and the 'FILTER' button to eliminate small instabilities on dc signals.

Access to the GPIB address and mode of operation is under the 'CHECK' function but to prevent unauthorized use in systems application this can be 'locked-out' resulting in a 100% tamper free front panel.

And emphasizing the system-oriented design even further, the standard facility for full electronic calibration allows simple recalibration either via the GPIB bus, or manually, without the need to open the case.

### Data Collection

The PM 2535 also has a 999-point buffer which is constantly active. This ensures that the last 999 measurements can be reviewed at any time.

The PM 2535 can measure at up to 150 measurements/sec, and by storing these directly in the internal buffer, more than 6 seconds of high-speed measurements can be collected regardless of the controller's speed.

### Controlling System 21 Modules

With the PM 2534 and PM 2535, System 21 can be added to any GPIB application to provide a modular and cost-effective solution to system switching. Both the PM 2534 and the PM 2535 have a System 21 master unit built-in, enabling them to control the PM 2120 universal switches or the PM 2121 low level switches.

GPIB
IEEE-488

RS-232

---

*The terms GPIB and IEEE-488 may be used interchaneably throughout this catalog.

# System/Bench Multimeters

## PM 2534 & PM 2535 System Multimeters

## Specifications

### Technical Specifications

#### DC Volts/DC Amps

| Ranges | Maximum Resolution | Accuracy: 5½ or 6½ Digits in % Rdg + % Range | | |
|---|---|---|---|---|
| | | 24 Hrs (tcal ±1°C) | 90 Days (tcal ±5°C) | 1 Year (tcal ±5°C) |
| 300 mV | 100 nV | 0.0025 + 0.0013* | 0.007 + 0.0017* | 0.012 + 0.0017* |
| 3V | 1 µV | 0.0020 + 0.0010 | 0.005 + 0.0013 | 0.010 + 0.0013 |
| 30V | 10 µV | 0.0025 + 0.0013 | 0.006 + 0.0017 | 0.015 + 0.0017 |
| 300V | 100 µV | 0.0025 + 0.0010 | 0.006 + 0.0013 | 0.010 + 0.0013 |
| 30 mA | 100 nA | 0.01 + 0.005 | 0.03 + 0.005 | 0.05 + 0.005 |
| 3A (<1A) | 10 µA | 0.01 + 0.005 | 0.03 + 0.005 | 0.05 + 0.005 |
| 3A (>1A) | 10 µA | 0.10 + 0.0 | 0.15 + 0.01 | 0.20 + 0.01 |

*Valid when using "NULL"

| Operation Modes Scale Length | Speed Measurements/Sec | Normal Mode Rejection | | Common Mode Rejection* | | |
|---|---|---|---|---|---|---|
| | | 50-60 Hz ±0.1% | 50-60 Hz ±1.0% | DC | 50-60 Hz ±0.1% | 50-60 Hz ±1.0% |
| 3000000 | 0.3 | >80 dB | >60 dB | >140 dB | >160 dB | >140 dB |
| 300000 | 3.0 | >70 dB | >50 dB | >140 dB | >150 dB | >130 dB |
| 30000 | 30 | >60 dB | >40 dB | >140 dB | >140 dB | >120 dB |
| 3000 | 100 (150)** | – | – | >140 dB | >80 dB | >80 dB |

*Measured with 1 kΩ unbalance and guard connected to CM voltage

**For PM 2535 using internal buffer

**Temperature Coefficient**
**Input Impedance:** DC volts, 10 MΩ
**DC Volts:** ±(0.002% reading + 0.0005% range)
**DC Amps:** ±(0.005% reading + 0.001% range)
**Maximum Input Voltage:** 600V peak, 300V continuous
**Maximum NM Voltage:** 140% of selected range

**Maximum CM Voltage:** 350V peak, lo to guard; 350V peak, guard to ground
**Filters:** User selectable digital
**Clip Indication:** † is displayed when input circuitry clips during measuring cycle
**Normal Mode Rejection** ±100 µV
**Protection:** 3.15A fuse

#### AC Volts (RMS)/AC Amps

| Ranges | Maximum Resolution | Input Characteristics | Accuracy: 4½ or 3½ Digits in % Reading + % Range Valid from 1% to 100% of Range | | | |
|---|---|---|---|---|---|---|
| | | | Frequency Range | 24 Hrs (tcal ±5°C) | 90 Days (tcal ±5°C) | 1 Year (tcal ±5°C) |
| 300 mV<br>3V | 10 µV<br>100 µV | 1.2 MΩ//30 pF | 40/400 Hz - 5 kHz | 0.10 + 0.10 | 0.20 + 0.10 | 0.30 + 0.10 |
| 30V<br>300V | 1 mV<br>10 mV | 0.93 MΩ//30 pF | 5 kHz-100 kHz (per kHz) | 0.02 + 0.02 | 0.04 + 0.02 | 0.06 + 0.02 |
| 30 mA | 1 µA | <250 mV drop | *40/400 Hz - 1 kHz | 0.1 + 0.1 | 0.2 + 0.10 | 0.3 + 0.1 |
| 3A | 100 µA | <600 mV drop | *40/400 Hz - 1 kHz | 0.1 + 0.1 | 0.2 + 0.10 | 0.3 + 0.1 |

*Analog Filter on/off

| Operation Modes Scale Length | Speed Measurements/Sec |
|---|---|
| 30000 | 2.5 |
| 3000 | 25 |

**Protection:** 3.15A fuse
**Crest Factor:** 3.3 at full scale, increasing down scale. Crest factor overload indicated by 1 on display.
**Temperature Coefficient:** <0.03%/°C
**Maximum Volt-Hertz Product:** $10^7$

**CMRR:** With 1 kΩ unbalance and guard to '0': >120 dB for dc signals; >80 dB for 50/60 Hz ac signals
**Maximum Input Voltage:** 600V peak, 400V continuous
**Input Impedance**
300mV & 3V: 1.2 MΩ//30 pF
30V & 300V: 0.93 MΩ//30 pF

# System/Bench Multimeters

## PM 2534 & PM 2535 System Multimeters

### Ohms (2-Wire and 4-Wire)

| Ranges | Maximum Resolution | Accuracy 6½ or 5½ Digits in % Reading + % Range | | | Input Characteristics (Non-Linear) |
|---|---|---|---|---|---|
| | | 24 Hrs (tcal ±1°C) | 90 Days (tcal ±5°C) | 1 Year (tcal ±5°C) | |
| 3 kΩ | 1 mΩ | 0.010 + 0.0033 | 0.02 + 0.0033 | 0.03 + 0.0033 | 1 mA drive |
| 30 kΩ | 10 mΩ | | | | 100 µA drive |
| 300 kΩ | 100 mΩ | | | | 10 µA drive |
| 3 MΩ | 1Ω | 0.020 + 0.0033 | 0.04 + 0.0033 | 0.05 + 0.0033 | 1 µA drive |
| 30 MΩ* | 100Ω | 0.060 + 0.0033 | 0.10 + 0.0033 | 0.15 + 0.0033 | 100 nA drive |
| 300 MΩ* | 10 kΩ | 0.8 + 0.033 | 1.6 + 0.033 | 2.0 + 0.033 | 10 nA drive |

*Only in 2-wire configuration

| Operation Modes Scale Length | Speed Measurements/Sec |
|---|---|
| 3000000 | 0.25 |
| 300000 | 2.5 |
| 30000 | 25 |
| 3000* | 65 |

*Excluding 3 MΩ, 30 MΩ and 300 MΩ ranges

### Temperature (via Pt 100 RTD probe)*

| Meter Ranges | Resolution | Accuracy | Measurements/Sec |
|---|---|---|---|
| -100°C to 850°C | 1.0° | 0.3% reading + 0.2°C | 30 |
| -100°C to +850°C | 0.1°C | 0.3% reading + 0.2°C | 3 |

*For optional accuracy see PM 9249/01 RTD Probe

**Maximum Open Circuit Voltage:** 10V
**Maximum 4-Wire Lead Resistance:** 100Ω
**Protection 2-Wire Terminals:** 250V ac or dc, 350V peak
**Protection 4-Wire Terminals:** 30V ac or dc, 42V peak
**Maximum CM Voltage:** 2-wire: 250V ac or dc, 350V peak between '0' and guard, or between guard and ground; 4-wire: 30V ac or dc, 42V peak between '0' and ground; guard must be connected to '0'
**Linearization:** According to DIN 43760
**Max Voltage:** Between '0' and guard 30V ac or dc, 42V peak

## General Specifications

### Power Requirements

**Power Supply:** 115V or 230V (±10%)
**Line Frequency:** 50 Hz or 60 Hz (±1%)
**Power Consumption:** 20 VA
**Safety Class:** IEC 348 Class I
**MTBF:** 32,000 hours
**Calibration Interval:** 1 year

### Environmental Data

**Reference Temperature:** 23°C ±1°C
**Rated Range of Use:** 0 to +50°C
**Operating Range:** 0 to +55°C
**Storage and Transport:** -25°C to +70°C
**Limits of Humidity for Operation:** 20 to 80%
**Max Dew Point:** +25°C

### Mechanical Data

**Size:** 280 W mm × 210 L mm × 86 H mm (11 W in × 8.3 L in × 3.4 H in.)
**Weight:** 2.9 kg (6.2 lb)

## Ordering Information

### Models

**PM 2534/02n** System Multimeter ***$1535***
**PM 2535/02n** System Multimeter ***$1800***
The **n** indicates the required line cord. To select your line cord substitute the **n** by:

1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

### Included with Instrument

One-year product warranty, set of safety test leads with probes, spare fuses, operator and service manuals.

**Accessories**

**PM 9280** Rack mount kit for 1 or 2 PM 2534/5 (2E height) ***$345***
**PM 2193/03** Rack Kit for PM 2534/5 and up to 4 system 21 modules (3E height). ***$325***
**PM 2194/02** Blank Panels for PM 2193 ***$105***
**PM 9071** Coax Cable, 135Ω, Banana ***$65***
**PM 9072** Coax Cable, 135Ω, BNC - Banana ***$65***
**PM 9190/02** RS-232C Interface ***$495***
**PM 9193/02** Analog Output Option ***$495***
**PM 9210** High Frequency 150 mV Probe, 10 kHz to 1 GHz ***$365***
**83RF** High Frequency Probe, 100 kHz to 100 MHz ***$89***
**PM 9244** AC and DC Current Shunt up to 31.6A ***$105***
**PM 9245** AC Current Transformer 10A to 150A ***$105***
**PM 9246/04** High Tension Probe ***$215***
**PM 9249/01** Temperature Probe ***$220***
**PM 9264/01** 4-wire Test Lead for resistor measurement ***$130***
**5440A-7002** Low Thermal Test Leads ***$475***
**PM 9266/04** Set of Test Leads with Probes ***$43***
**PM 9267/01** Data Hold Probe ***$215***
**PM 9280/04** 19" Rack Mount Adapter (2E height) ***$345***
Manuals see page 65.

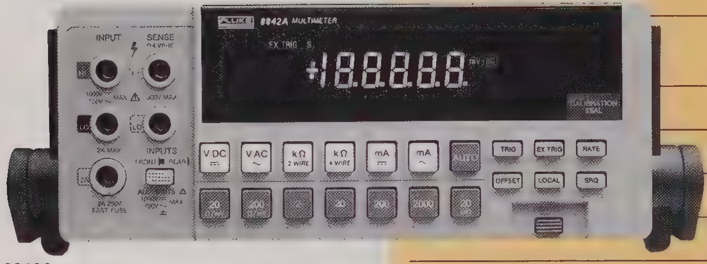
## Customer Support Services

### Factory Warranty

One-year product warranty.

# System/Bench Multimeters

## 8840A 5½ Digit Multimeter



8842A

- 0.005% basic 1 year dc accuracy
- Ohms and dc current standard – ac voltage and current optional
- Full system capability with IEEE-488 interface
- Up to 100 readings/second system speed
- Easy-to-use front panel
- Vacuum fluorescent display
- Closed-case calibration – comprehensive self-test

## 8842A 5½ Digit Multimeter – The 8840A with higher accuracy and sensitivity

- 0.003% basic 1 year dc accuracy
- Increased resolution with 20 mV, 200 mA, and 20Ω ranges
- Extended calibration cycle with 2 year specifications
- Two-year warranty

### Performance

The 8840 Series has performance you would expect in multimeters costing much more. Basic dc accuracies to 0.003% and basic ac accuracies to 0.08% at one year are available. See the specifications that follow for complete information on measurement ranges and accuracy.

### Powerful System Capabilities

The 884X/059 models adds the IEEE-488 interface to the 8840 Series provides system capability which includes complete system control of functions, ranges, and reading rates. Front and rear panel inputs are switch-selectable from the front panel (and you can sense the status of the switch over the bus). Calibration and self-test can also be controlled over the bus.

Powerful yet simple device dependent IEEE-488 code allows the 8840 Series DMMs to be easily integrated into your system. System software written for the 8840A is compatible with the 8842A.

The mechanical design also contributes to performance and convenience in system applications. The 8840A Series' metal case provides EMI shielding to ensure measurement integrity. The unit can be mounted in a half-rack slot simply by removing the handle, turning the "twist-away" rear feet, and bolting on rack mount brackets.

Embodying all these features, the 8840 Series DMMs are fully programmable, powerful digital multimeters within reach of every system builder.

### Self-Testing

The 8840 Series automatically performs a digital self-test each time it is powered up. Additionally, you can initiate a comprehensive analog and digital diagnostic self-test from the front panel or through the IEEE-488 interface.

### Closed-Case Calibration

No internal adjustments are required for calibration. After you initiate calibration via a recessed front panel switch, you are led through a software controlled procedure that even double checks to ensure that appropriate reference inputs have been applied. Calibration can be performed under front panel or IEEE-488 control.

### Technology

**A monolithic A/D converter** uses a proprietary CMOS IC designed to achieve the superb accuracy, speed, and reliability of the 8840 Series.

**Analog switch ICs** developed and manufactured by Fluke replace discrete switching devices to create superior performance, reliability, and serviceability.

**A voltage reference device** similar to that found in the Fluke 732B DC Reference Standard provides unmatched stability.

**Precision thin film resistor networks** establish the accuracy and maintain the stability of the 8840 Series.

## 8842A Specifications

### Technical Specifications

### DC Voltage

**Input Characteristics**

| Range | Full Scale 5½ Digits | Resolution | | Input Resistance |
|---|---|---|---|---|
| | | 5½ Digits | 4½* Digits | |
| 20 mV | 19.9999 mV | 0.1 µV | 1 µV | ≥10,000 MΩ |
| 200 mV | 199.999 mV | 1 µV | 10 µV | ≥10,000 MΩ |
| 2V | 1.99999V | 10 µV | 100 µV | ≥10,000 MΩ |
| 20V | 19.9999V | 100 µV | 1 mV | ≥10,000 MΩ |
| 200V | 199.999V | 1 mV | 10 mV | 10 MΩ |
| 1000V | 1000.00V | 10 mV | 100 mV | 10 MΩ |

*4½ digits at the fastest reading rate

# System/Bench Multimeters

## 8840A/42A 5½ Digit Multimeter

**Accuracy**
**Normal (S) Reading Rates:** ± (% of Reading + Number of Counts)

| Range | 24 Hour[1]<br>23±1°C | 90 Day<br>23±5°C | 1 Year<br>23±5°C | 2 Year<br>23±5°C |
|---|---|---|---|---|
| 20 mV[2] | 0.0050 + 20 | 0.0070 + 30 | 0.0100 + 30 | 0.0120 + 40 |
| 200 mV[2] | 0.0030 + 2 | 0.0045 + 3 | 0.0070 + 3 | 0.0100 + 4 |
| 2V | 0.0015 + 2 | 0.0025 + 2 | 0.0030 + 2 | 0.0050 + 3 |
| 20V | 0.0015 + 2 | 0.0030 + 2 | 0.0035 + 2 | 0.0060 + 3 |
| 200V | 0.0015 + 2 | 0.0030 + 2 | 0.0035 + 2 | 0.0060 + 3 |
| 1000V | 0.0020 + 2 | 0.0035 + 2 | 0.0045 + 2 | 0.0070 + 3 |

**Medium and Fast Rates:** In medium rate, add 3 counts (20 counts on 20 mV range) to number of counts. In fast rate, use two 4½ digit counts (30 counts on 20 mV range) for the number of counts

**Operating Characteristics**
**Temperature Coefficient:** >±(0.0006% of Reading + 0.3 Count) per °C from 18°C to 0°C and 28°C to 50°C
**Maximum Input:** 1000V dc or peak ac on any range
**Noise Rejection:** Automatically optimized at power-up for 50, 60 or 400 Hz

[1] Relative to calibration standards
[2] Within one hour of dc zero, using offset control

| Rate | Readings/Second[1] | Filter | NMRR[2] | Peak NM Signal | CMRR[3] |
|---|---|---|---|---|---|
| S | 2.5[5] | Analog & Digital | >98 dB | 20V or 2xFS[4] | >140 dB |
| M | 20[6] | Digital | >45 dB | 1xFS | >100 dB |
| F | 100 | None | – | 1xFS | >60 dB |

[1] Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail.
[2] Normal Mode Rejection Ratio, at 50 Hz or 60 Hz ±0.1%. The NMRR for 400 Hz ±0.1% is 85 dB in S rate and 35 dB in M rate.
[3] Common Mode Rejection Ratio at 50 Hz or 60 Hz ±0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates.
[4] 20V or 2 times Full Scale whichever is greater, not to exceed 1000V
[5] Reading rate – .31 rdg/sec in the 20 mV, 20Ω, 200 mA dc ranges
[6] Reading rate – 1.25 rdg/sec in the 20 mV, 20Ω, 200 mA dc ranges

## True-RMS AC Voltage (8842A/059)

**Input Characteristics**

| Range | Full Scale 5½ Digits | Resolution 5½ Digits | 4½* Digits | Input Resistance |
|---|---|---|---|---|
| 200mV | 199.999 mV | 1 µV | 10 µV | 1 MΩ shunted by <100 pF |
| 2V | 1.99999V | 10 µV | 100 µV | |
| 20V | 19.9999V | 100 µV | 1 mV | |
| 200V | 199.999V | 1 mV | 10 mV | |
| 700V | 700.00V | 10 mV | 100 mV | |

*4½ digits at the fastest reading rate

**Accuracy**
**Normal (S) Reading Rates:** ± (% of Reading + Number of Counts)[1]

| Freq (Hz) | 24 Hour[2]<br>23 ±°C | 90 Day<br>23±5°C | 1 Year<br>23±5°C | 2 Year<br>23±5°C |
|---|---|---|---|---|
| 20-45 | 1.2 + 100 | 1.2 + 100 | 1.2 + 100 | 1.2 + 100 |
| 45-200 | 0.3 + 100 | 0.35 + 100 | 0.4 + 100 | 0.5 + 100 |
| 200-20k (200 mV) | 0.06 + 100 | 0.08 + 100 | 0.10 + 100 | 0.20 + 100 |
| (2-200V) | 0.05 + 80 | 0.07 + 80 | 0.08 + 80 | 0.15 + 80 |
| (700V) | 0.06 + 100 | 0.08 + 100 | 0.10 + 100 | 0.20 + 100 |
| 20-50k | 0.15 + 120 | 0.19 + 150 | 0.21 + 200 | 0.25 + 250 |
| 50-100k | 0.4 + 300 | 0.5 + 300 | 0.5 + 400 | 0.5 + 500 |

[1] For sinewave inputs between 1000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz
[2] Relative to calibration standard

**Medium and Fast Reading Rates:** In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥1000 4½ digit counts and >100 Hz.
**Nonsinusoidal Inputs:** For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, add the following % of reading to the accuracy specifications

| Fundamental Frequency | Crest Factor 1.0 - 1.5 | 1.5 - 2.0 | 2.0 - 3.0 |
|---|---|---|---|
| 45 Hz to 20 kHz | 0.05% | 0.15% | 0.3% |
| 20 Hz to 45 Hz & 20 kHz to 50 kHz | 0.2% | 0.7% | 1.5% |

**Operating Characteristics**
**Maximum Input:** 700V rms, 1000V peak or 2 × $10^7$ volt-hertz product (whichever is less) for any range
**Temperature Coefficient:** ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

| For Inputs | Frequency in Hertz 20 - 20k | 20k - 50k | 50k - 100k |
|---|---|---|---|
| ≥10,000 counts | 0.019 + 9 | 0.021 + 9 | 0.027 + 10 |
| ≥1,000 counts | 0.019 + 12 | 0.021 + 15 | 0.027 + 21 |

**Common Mode Rejection:** >60 dB at 50 Hz or 60 Hz with1 kΩ in either lead

## Current

**Input Characteristics**

| Range | Full Scale 5½ Digits | Resolution 5½ Digits | 4½ Digit[1] |
|---|---|---|---|
| 200 mA[2] | 199.999 mA | 1 µA | 10 µA |
| 2000 mA | 1999.99 mA | 10 µA | 100 µA |

[1] 4½ digits at the fastest reading rate
[2] 200 mA range is dc only

**DC Accuracy**
**Normal (S) Reading Rate:** ±(% of Reading + Number of Counts)

| Range | 90 Day<br>23±5°C | 1 Year<br>23°C ±1°C | 2 Year<br>23±5°C |
|---|---|---|---|
| 200 mA | 0.04 + 40 | 0.05 + 40 | 0.08 + 40 |
| 2000 mA | | | |
| ≤1A | 0.04 + 4 | 0.05 + 4 | 0.08 + 4 |
| >1A | 0.1 + 4 | 0.1 + 4 | 0.15 + 4 |

**Medium and Fast Rates:** In medium reading rate, add 2 counts (20 counts on 20 mA range) to number of counts. In fast reading rate, use two 4½ digit counts (20 counts on 200 mA range) for number of counts.
**AC Accuracy:** (8842A/059)
**Normal (S) Reading Rate:** ±(% of Reading + Number of Counts) 23° ±5°C, for sinewave inputs ≥10,000 counts

## 8840A/42A 5½ Digit Multimeter

| Time | Frequency in Hertz | | |
|---|---|---|---|
| | 20-45 | 45-100 | 100-5k* |
| One Year | 2.0 + 200 | 0.5 + 200 | 0.4 + 200 |
| Two Years | 3.0 + 300 | 0.7 + 300 | 0.6 + 300 |

**Medium and Fast Reading Rates:** In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ≥1000 4½ digit counts and frequencies >100 Hz, the accuracy is ±(0.4% of reading + 30 counts)

**Nonsinusoidal Inputs:** For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, add the following % of reading to the accuracy specifications

* Typically 20 kHz

| Fundamental Frequency | Frequency in Hertz | | |
|---|---|---|---|
| | 1.0 - 1.5 | 1.5 - 2.0 | 2.0 - 3.0 |
| 45 Hz to 5 kHz | 0.05 | 0.15 | 0.3 |
| 20 Hz to 45 Hz | 0.2 | 0.7 | 1.5 |

**Operating Characteristics**

**Temperature Coefficient:** Less than 0.1 × accuracy specifications per °C from 0°C to 18°C and 28°C to 50°C

**Maximum Input:** 2A dc or rms ac. Protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse.

**Burden Voltage:** 1V dc or rms ac typical at full scale

### Resistance

**Input Characteristics**

| Range | Full Scale 5½ Digits | Resolution | | Current Through Unknown |
|---|---|---|---|---|
| | | 5½ Digits | 4½[1] Digits | |
| 20Ω[2] | 19.9999Ω | 0.1 mΩ | 1 mΩ | 1 mA |
| 200Ω | 199.999Ω | 1 mΩ | 10 mΩ | 1 mA |
| 2 kΩ | 1.99999 kΩ | 10 mΩ | 100 mΩ | 1 mA |
| 20 kΩ | 19.9999 kΩ | 100 mΩ | 1Ω | 100 μA |
| 200 kΩ | 199.999 kΩ | 1Ω | 10Ω | 10 μA |
| 2000 kΩ | 1999.99 kΩ | 10Ω | 100Ω | 5 μA |
| 20 MΩ | 19.9999 MΩ | 100Ω | 1 kΩ | 0.5 μA |

[1] 4½ digits at the fastest reading rate
[2] 4-wire ohms only

**Resistance Accuracy**

**Normal (S) Reading Rate:** ± (% of Reading + Number of Counts)[1]

| Range | 24 Hour[2] 23 ±1°C | 90 Day 23±5°C | 1 Year 23±5°C | 2 Year 23±5°C |
|---|---|---|---|---|
| 20Ω[3] | 0.007 + 30 | 0.009 + 40 | 0.012 + 40 | 0.015 + 40 |
| 200Ω[3] | 0.0040 + 3 | 0.007 + 4 | 0.010 + 4 | 0.012 + 4 |
| 2 kΩ | 0.0025 + 2 | 0.005 + 3 | 0.008 + 3 | 0.010 + 3 |
| 20 kΩ | 0.0025 + 2 | 0.005 + 3 | 0.008 + 3 | 0.010 + 3 |
| 200 kΩ | 0.0025 + 2 | 0.006 + 3 | 0.010 + 3 | 0.012 + 3 |
| 2000 kΩ | 0.023 + 3 | 0.025 + 3 | 0.027 + 3 | 0.030 + 3 |
| 20 MΩ | 0.023 + 3 | 0.040 + 4 | 0.042 + 4 | 0.050 + 4 |

[1] Within one hour of ohms zero, using offset control
[2] Relative to calibration standards
[3] 4-wire ohms only

**Medium and Fast Reading Rates:** In medium rate, add 2 counts to the number of counts for the 200Ω through 200 kΩ ranges, 3 counts for the 2000 kΩ and 20 MΩ ranges, and 20 counts for the 20Ω range. In fast reading rate, use three 4½ digit for the number of counts for the 200Ω range, 20 4½ digit counts for the 20Ω range, and two 4½ digit for all other ranges.

**Operating Characteristics**

**Temperature Coefficient:** Less than 0.1 × accuracy specification per °C from 0°C to 18°C and 28°C to 50°C

**Measurement Configuration:** 2-wire or 4-wire (20Ω range is 4-wire only)

**Open Circuit Voltage:** Less than 6.5V on the 20Ω through 200 kΩ ranges. Less than 13V on the 2000 kΩ and 20 MΩ ranges

**Input Protection:** To 300V rms

**Reading Rates and Ranging**

**Reading Rates with Internal Trigger**
(readings per second)

| Rate | Power Line Frequency[1] | | |
|---|---|---|---|
| | 50 Hz | 60 Hz | 400 Hz |
| S | 2.08 (.26[2]) | 2.5 (.31[2]) | 2.38 (.30[2]) |
| M | 16.7 (1.04[2]) | 20 (1.25[2]) | 19.0 (1.19[2]) |
| F | 100 | 100 | 100 |

[1] Sensed automatically at power-up
[2] In the 20 mV, 20Ω, and 200 mA ranges. The 8842A does not autorange down into these ranges. To access these ranges, select the specific range, from the front panel or over the bus.

### IEEE-488 Interface (8842A/059)

Allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E1, PP0 and C0.

## General Specifications

**Common Mode Voltage:** 1000V dc or peak ac, or 700V rms ac from any input to earth ground

**Temperature Range:** 0 to 50°C operating; −40°C to 70°C storage

**Humidity Range:** 80% RH from 0°C to 35°C; 70% to 50°C

**Warmup Time:** 1 hour to rated specifications

**Power:** 100V, 120V, 220V, or 240V ac ±10% (250V ac maximum), switch-selectable at rear panel; 50 Hz, 60 Hz, or 400 Hz, automatically sensed at power up; 20 VA maximum

**Vibration:** Meets requirements of MIL-T-28800C for Type III, Class 3, Style E equipment

**Safety:** ANSI C39.5 and IEC 348, Class I, VDE 0411 Marks License, and CSA Bulletin 556B

**Size:** 89 mm H × 216 mm W × 371 mm L (3.5 in H × 8.5 in W × 14.6 in L)

**Weight:** Net, 3.4 kg (7.5 lb); shipping, 5 kg (11 lb)

## Ordering Information

### Models

**8842A*** Basic Digital Multimeter (DC and SL) ***$1210***

**8842A/059** w/IEEE-488 & True-RMS AC ***$1650***

### Included with Instrument

Two-year product warranty, line cord, TL70A test leads, Operator/Service Manual, IEEE-488 Quick Reference Guide, Performance Verification Record, and Certificate of Calibration Practices.

### Options (for 8842A)

**884XA-05K** IEEE-488 Interface Field Kit ***$220***

**8842A/09K*** True-RMS AC Option Field Kit ***$330***

*Requires recalibration

### Accessories

**Y8834** 3½″ Rack Mount Kit Single ***$90***

**Y8835** 3½″ Rack Mount Kit, Dual ***$155***

**Y8836** 3½″ Rack Mount Kit, Center ***$90***

**Y8021** IEEE-488 Shielded Cable, 1m ***$195***

**Y8022** IEEE-488 Shielded Cable, 2m ***$210***

**Y8023** IEEE-488 Shielded Cable, 4m ***$220***

### Manuals

**8842A** Getting Started* ***$9***

**8842A-IEEE-488** Quick Ref. Guide* ***$1***

**8842A** Operator & Service* ***$45***

*No charge with purchase of unit

## Customer Support Services

### Factory Warranty

Two-year product warranty.

# System/Bench Multimeters

## 8840A/42A 5½ Digit Multimeter

## 8840A Specifications

### Technical Specifications

### DC Voltage

**Input Characteristics**

| Range | Full Scale 5½ Digits | Resolution 5½ Digits | Resolution 4½* Digits | Input Resistance |
|---|---|---|---|---|
| 200 mV | 199.999 mV | 1 µV | 10 µV | ≥10.000 MΩ |
| 2V | 1.99999V | 10 µV | 100 µV | ≥10.000 MΩ |
| 20V | 19.9999V | 100 µV | 1 mV | ≥10.000 MΩ |
| 200V | 199.999V | 1 mV | 10 mV | 10 MΩ |
| 1000V | 1000.00V | 10 mV | 100 mV | 10 MΩ |

*4½ digits at the fastest reading rate

**Accuracy**

**Normal (S) Reading Rates:** ±(% of Reading + Number of Counts)

| Range | 24 Hour[1] 23±1°C | 90 Day 23±5°C | 1 Year 23±5°C |
|---|---|---|---|
| 200 mV[2] | 0.003 + 3 | 0.007 + 4 | 0.008 + 4 |
| 2V | 0.002 + 2 | 0.004 + 3 | 0.005 + 3 |
| 20V | 0.002 + 2 | 0.005 + 3 | 0.006 + 3 |
| 200V | 0.002 + 2 | 0.005 + 3 | 0.006 + 3 |
| 1000V | 0.003 + 2 | 0.005 + 3 | 0.007 + 3 |

[1] Relative to calibration standards

[2] Using offset control

**Medium and Fast Rates:** In medium rate, add 2 counts. In fast rate, use three 4½ digit counts.

**Operating Characteristics**

**Temperature Coefficient:** >±0.006% of reading + 0.3 count) per °C from 18°C to 0°C and 28°C to 50°C

**Maximum Input:** 1000V dc or peak ac on any range

**Noise Rejection:** Automatically optimized at power-up for 50 Hz, 60 Hz or 400 Hz

| Rate | Readings/Second[1] | Filter | NMRR[2] | Peak NM Signal | CMRR[3] |
|---|---|---|---|---|---|
| S | 2.5 | Analog & Digital | >98 dB | 20V or 2xFS[4] | >140 dB |
| M | 20 | Digital | >45 dB | 1xFS | >100 dB |
| F | 100 | None | – | 1xFS | >60 dB |

[1] Reading rate with internal trigger and 60 Hz power line frequency. See "Reading Rates" for more detail.

[2] Normal Mode Rejection Ratio, at 50 Hz or 60 Hz ±0.1%. The NMRR for 400 Hz ±0.1% is 85 dB in S rate and 35 dB in M rate.

[3] Common Mode Rejection Ratio at 50 Hz or 60 Hz ±0.1%, with 1 kΩ in series with either lead. The CMRR is >140 dB at dc for all reading rates.

[4] 20V or 2 times Full Scale whichever is greater, not to exceed 1000V

### True-RMS AC Voltage (8840A/059)

**Input Characteristics**

| Range | Full Scale 5½ Digits | Resolution 5½ Digits | Resolution 4½* Digits | Input Resistance |
|---|---|---|---|---|
| 200 mV | 199.999 mV | 1 µV | 10 µV | 1 MΩ shunted by >100 pF |
| 2V | 1.99999V | 10 µV | 100 µV | |
| 20V | 19.9999V | 100 µV | 1 mV | |
| 200V | 199.999V | 1 mV | 10 mV | |
| 700V | 700.00V | 10 mV | 100 mV | |

*4½ digits at the fastest reading rate

**Accuracy**

**Normal (S) Reading Rates:** ±(% of Reading + Number of Counts) for sinewave inputs ≥10,000 counts[1] (5% of range)

| Frequency Hz | 24 Hour[2] 23 ±°C | 90 Day 23±5°C | 1 Year 23±5°C |
|---|---|---|---|
| 20-45 | 1.2 + 100 | 1.2 + 100 | 1.2 + 100 |
| 45-100 | 0.3 + 100 | 0.35 + 100 | 0.4 + 100 |
| 100-20k | 0.07 + 100 | 0.14 + 100 | 0.16 + 100 |
| 20k-50k | 0.15 + 120 | 0.19 + 150 | 0.21 + 200 |
| 50k-100k | 0.4 + 300 | 0.5 + 300 | 0.5 + 400 |

[1] For sinewave inputs between 1000 and 10,000 counts, add to Number of Counts 100 counts for frequencies 20 Hz to 20 kHz, 200 counts for 20 kHz to 50 kHz, and 500 counts for 50 kHz to 100 kHz

[2] Relative to calibration standards

**Medium and Fast Reading Rates:** In medium rate, add 50 counts to number of counts. In fast rate the specifications apply for sinewave inputs ≥1000 4½ digit counts and >100 Hz.

**Operating Characteristics**

**Temperature Coefficient:** ±(% of Reading + Number of Counts) per °C, 0°C to 18°C and 28°C to 50°C

| For Inputs | Frequency in Hertz 20-20k | 20k-50k | 50k-100k |
|---|---|---|---|
| ≥10,000 counts | 0.019 + 9 | 0.021 + 9 | 0.027 + 10 |
| ≥1000 counts | 0.019 + 12 | 0.021 + 15 | 0.027 + 21 |

**Nonsinusoidal Inputs:** For nonsinusoidal inputs ≥10,000 counts with frequency components ≤100 kHz, add the following % of reading to the accuracy specifications

| Fundamental Frequency | Crest Factor 1.0 - 1.5 | 1.5 - 2.0 | 2.0 - 3.0 |
|---|---|---|---|
| 45 Hz to 20 kHz | 0.05% | 0.15% | 0.3% |
| 20 Hz to 45 Hz & 20 kHz to 50 kHz | 0.2% | 0.7% | 1.5% |

**Maximum Input:** 700V rms, 1000V peak or 2 × $10^7$ volt-hertz product (whichever is less) for any range

**Common Mode Rejection:** >60 dB at 50 Hz or 60 Hz with 1 kΩ in either lead

### Current

**Input Characteristics**

| Range | Full Scale 5½ Digits | Resolution 5½ Digits | Resolution 4½ Digit * |
|---|---|---|---|
| 2000 mA | 1999.99 mA | 10 µA | 100 µA |

*4½ digits at the fastest reading rate

**DC Accuracy**

**Normal (S) Reading Rate:** ±(% of Reading + Number of Counts)

| Range | 90 Days 23 ±5°C | 1 Year 23 ±5°C |
|---|---|---|
| ≤1A | 0.04 + 4 | 0.05 + 4 |
| >1A | 0.1 + 4 | 0.1 + 4 |

**Medium and Fast Reading Rates:** In medium reading rate, add 2 counts (20 counts on 20 mA range) to number of counts. In fast reading rate, use two 4½ digit counts (20 counts on 200 mA range) for number of counts.

**AC Accuracy:** (Requires Option -09)

**Normal (S) Reading Rate:** ±(% of Reading + Number of Counts) 23° ±5°C, for sinewave inputs ≥10,000 counts

| Time | Frequency in Hertz 20-45 | 45-100 | 100-5k* |
|---|---|---|---|
| One Year | 2.0 + 200 | 0.5 + 200 | 0.4 + 200 |

*Typically 20 kHz

**Medium and Fast Reading Rates:** In medium reading rate, add 50 counts to number of counts. In fast reading rate, for sinewave inputs ≥1000 4½ digit counts and frequencies >100 Hz, the accuracy is ± (0.4 % of reading + 30 counts).

**Operating Characteristics**

**Temperature Coefficient:** Less than 0.1 × accuracy specifications per °C from 0°C to 18°C and 28°C to 50°C

**Maximum Input:** 2A dc or rms ac protected with 2A, 250V fuse accessible at front panel, and internal 3A, 600V fuse.

**Burden Voltage:** 1V dc or rms ac typical at full scale

# 8840A/42A 5½ Digit Multimeter

## Resistance

### Input Characteristics

| Range | Full Scale 5½ Digits | Resolution |  | Input Resistance |
|---|---|---|---|---|
|  |  | 5½ Digits | 4½* Digits |  |
| 200Ω | 199.999Ω | 1 mΩ | 10 mΩ | 1 mA |
| 2 kΩ | 1.99999 kΩ | 10 mΩ | 100 mΩ | 1 mA |
| 20 kΩ | 19.9999 kΩ | 100 mΩ | 1Ω | 100 µA |
| 200 kΩ | 199.999 kΩ | 1Ω | 10Ω | 10 µA |
| 2000 kΩ | 1999.99 kΩ | 10Ω | 100Ω | 5 µA |
| 20 MΩ | 19.9999 MΩ | 100Ω | 1 kΩ | 0.5 µA |

*4½ digits at the fastest reading rate

**Accuracy**

**Normal (S) Reading Rate:** ± (% of Reading + Number of Counts)[1]

| Range | 24 Hour[2] 23 ±1°C | 90 Day 23±5°C | 1 Year 23±5°C |
|---|---|---|---|
| 200Ω[3] | 0.004 + 3 | 0.011 + 4 | 0.014 + 4 |
| 2 kΩ | 0.0028 + 2 | 0.01 + 3 | 0.013 + 3 |
| 20 kΩ | 0.0028 + 2 | 0.01 + 3 | 0.013 + 3 |
| 200 kΩ | 0.0028 + 2 | 0.01 + 3 | 0.013 + 3 |
| 2000 kΩ | 0.023 + 3 | 0.027 + 3 | 0.028 + 3 |
| 20 MΩ | 0.023 + 3 | 0.043 + 4 | 0.044 + 4 |

[1] Using offset control

[2] Relative to calibration standards

[3] Applies to 4 wire ohms only

**Medium and Fast Reading Rates:** In medium rate, add to the number of counts 2 counts for the 200Ω through 200 kΩ ranges and 3 counts for the 2000 kΩ and 20 MΩ ranges. In fast reading rate, use for the number of counts three 4½ digit counts for the 200Ω range, and two 4½ digit counts.

**Operating Characteristics**

**Temperature Coefficient:** Less than 0.1 × accuracy specification per °C from 0°C to 18°C and 28°C to 50°C

**Measurement Configuration:** 2-wire or 4-wire

**Open Circuit Voltage:** Less than 6.5V on the 20Ω through 200 kΩ ranges, less than 13V on the 2000 kΩ and 20 MΩ ranges.

**Input Protection:** To 300V rms

**Reading Rates**

**Reading Rates With Internal Trigger** (readings per second)

| Rate | Power Line Frequency* |  |  |
|---|---|---|---|
|  | 50 Hz | 60 Hz | 400 Hz |
| S | 2.08 | 2.5 | 2.38 |
| M | 16.7 | 20 | 19.0 |
| F | 100 | 100 | 100 |

* Sensed automatically at power-up

## IEEE-488 Interface (8840A/059)

Allows complete control and data output capability, and supports the following interface function subsets: SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E1, PP0 and C0.

## General Specifications

**Common Mode Voltage:** 1000V dc or peak ac, or 700V rms ac from any input to earth ground

**Temperature Range:** 0°C to 50°C operating; −40°C to 70°C storage

**Humidity Range:** 80% RH from 0°C to 35°C; 70% to 50°C

**Warmup Time:** 1 hour to rated specifications

**Power:** 100V, 120V, 220V, or 240V ac ±10% (250V ac maximum), switch-selectable at rear panel; 50 Hz, 60 Hz, or 400 Hz, automatically sensed at power up; 20 VA maximum

**Vibration:** Meets requirements of MIL-T- 28800C for Type III, Class 3, Style E equipment

**Safety:** ANSI C39.5 and IEC 348, Class I, VDE 0411 Marks License, and CSA Bulletin 556B

**Size:** 89 mm H × 216 mm W × 371 mm L (3.5 in H × 8.5 in W × 14.6 in L)

**Weight:** Net, 3.4 kg (7.5 lb); shipping 5 kg (11 lb)

## Ordering Information

### Models

**8840A*** Basic Digital Multimeter (DC and Ω) ***$970***

**8840A/059** w/IEEE-488 & True-RMS AC ***$1400***

### Included with Instrument

One-year product warranty, line cord, TL70A test leads, Operator/Service Manual, IEEE-488 Quick Reference Guide, Performance Verification Record, and Certificate of Calibration Practices.

### Options (for 8840A)

**884XA-05K** IEEE-488 Interface Field Kit ***$220***

**8840A/09K*** True-RMS AC Option Field Kit ***$265***

*Requires recalibration

### Accessories

**Y8834** 3½" Rack Mount Kit Offset, Single ***$90***

**Y8835** 3½" Rack Mount Kit, Dual ***$155***

**Y8836** 3½" Rack Mount Kit, Center ***$90***

**Y8021** IEEE-488 Shielded Cable, 1m ***$195***

**Y8022** IEEE-488 Shielded Cable, 2m ***$210***

**Y8023** IEEE-488 Shielded Cable, 4m ***$220***

**Y8077** Four Terminal Short ***$55***

### Manuals

**8840A** Getting Started* ***$9***

**8840A-IEEE-488** Quick Ref. Guide* ***$1***

**8840A** Operator & Service* ***$45***

*No charge with purchase of unit

## Customer Support Services

### Factory Warranty

One-year product warranty.

# System/Bench Multimeters

## PM 2525 Digital Multifunctional Multimeter

4½ to 5½ digit meter with 1 µV resolution (0.02% ±2 digits)

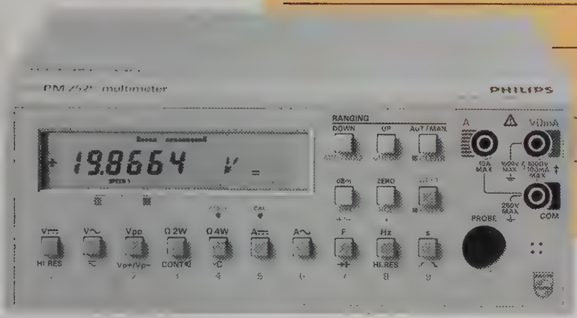
More measurement functions (Hz, time, capacitance, temp, etc)

Battery option for field use

GPIB/IEEE-488, RS-232C and analog output options for system operation

Simple command structure for system programming

Comprehensive overload protection



PM 2525

### PM 2525 Measurement Center

The PM 2525 is a very high functionality instrument, offering a full range of standard DMM measurement features plus a range of unique extra functions, making it a complete **"measurement center."**

Besides standard functions such as 8 current, 5 voltage and 7 resistance ranges, the PM 2525 also has the additional features of measurement of frequency, time, temperature, capacitance, dB and continuity.

For precision measurements the PM 2525 includes a 21,000 count facility plus a high resolution mode of 210,000 counts. This gives a resolution down to 1 µV for V dc; 100 pA for ac and dc current; 10 mΩ for resistance; and 1 pF for capacitance.

### Bench, Battery or System Versions

The PM 2525 is available in five versions covering most applications:

1. **Basic benchtop model:** For use in laboratory, workshop and production environments.
2. **Battery model:** For field use. Rechargeable battery for 5 hours operation included.
3. **Instrument with an analog output:** For analog registration of the results.
4. **GPIB/IEEE-488* interface version:** For operation with IEEE systems.
5. **RS-232 instrument:** For operation with a computer.

The last two interface versions allow remote control of all instrument settings and downloading of measured values to a computer or system controller. These versions are supplied with special interface software which has the same command structure, in plain English, used by Fluke system multimeters. The instrument has an additional high speed mode which provides 3½ digit V dc measurements at a rate of approximately 10 measurements/second.

### Fast Result with Min/Max, Peak-Peak, dBm

A number of special measuring capabilities not only makes measurement easier but allows the user to reach conclusions faster. For practically all measurements the min/max function can be switched in. This function displays the maximum and minimum reading over a given period, for all measurement functions. Volt peak-peak gives the instant peak voltage. A selection can be made for positive, negative or peak-to-peak values. Adjustments can be made easily by using the dBm function.

For both ac and dc voltage, the measurement can be read in dBm. And, since the reference resistance can be easily selected as well, levels can be quickly compared to a known reference.

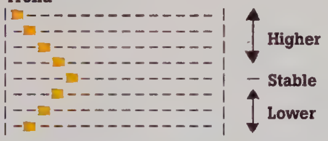
### More Functions, More Value

| | Ranges | Resolution | Accuracy |
|---|---|---|---|
| V DC | 5 | 1 µV | 0.02% |
| V AC | 5 | 10 µV | 0.2% |
| VT RMS | 5 | 10 µV | 0.2% |
| V Peak-Peak | 4 | 1 mV | 1.0% |
| IDC | 8 | 100 pA | 0.1% |
| IAC | 8 | 100 pA | 0.4% |
| R (2-wire) | 7 | 10 mΩ | 0.1% |
| R (4-wire) | 5 | 10 mΩ | 0.1% |
| Hz | 4 | 0.1 Hz | 0.01% |
| Capacitance | 6 | 1 pF | 1.0% |
| Time | 5 | 10 µsec | 0.01% |
| Temperature | – | 0.1°C | 0.3% |
| Diode | – | 100 µV | |
| dBm | 5 | 0.1 dB | ±0.4 dB |

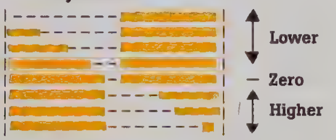
### Trend Display with an Analog Bargraph

The PM 2525 has an analog bargraph display for optimal presentation of signal trends and precision detection of peak, through or null value, which is particularly valuable for peak tuning of communication equipment. The rotating bargraph indicator on the LCD display steps in proportion to the voltage trend. With a 5V signal, the resolution is 0.01V per step, much higher than can normally be achieved with conventional analog multimeters.

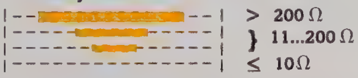
**Trend**



**Zero Adjustment**



**Continuity Check** in function **Cont**



### Relative Measurements

Adjustments are easily made by presetting a value as a reference zero by a single touch of the zero-set button. Deviation, positive or negative from the set zero, is then immediately and clearly displayed. Also the bargraph function can be used in the same way so that the bargraph then acts as a very sensitive minus-null-plus indicator.

### Overload Protection

The PM 2525 also includes comprehensive overload protection. All voltage ranges can handle peak transients of up to 2.5 kV without damage, while all other ranges are protected against accidental connection to normal power supplies. The instrument is electronically protected on current ranges up to 1 mA and by a fuse for the 10 mA and 100 mA ranges. The 1A and 10A ranges have a separate input socket.

GPIB IEEE-488

RS-232

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*The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

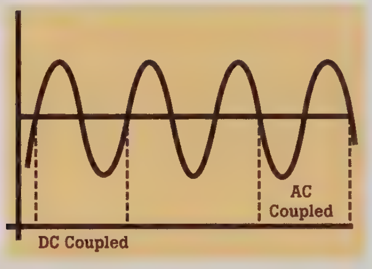
## PM 2525 Digital Multifunctional Multimeter

### Current Measurement with Low Voltage Drop

For measurements up to 1 mA the PM 2525 is equipped with a unique current-compensation system that virtually eliminates voltage drops across the meter input, eliminating a common source of significant errors in low current measurements.

### Choice of AC or DC Coupled True RMS Measurements

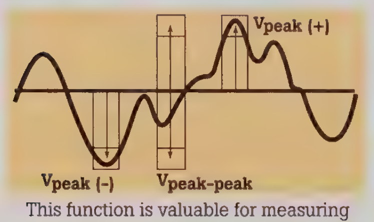
For accurate measurements of ac and ac + dc signal components regardless of the waveform.



True rms measurements are only possible with dc coupling since the dc component is an important part of the total signal energy. But ac coupling is essential for accurate measurements of ac components on large dc signals. The PM 2525 rms measurement function always gives accurate rms readings in both ac and dc coupled modes and even with highly distorted signal waveforms.

### Accurate Measurement of Peak Values

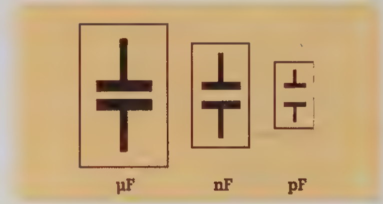
Direct measurement of positive, negative and peak-to-peak values over approximately 1 sec.



This function is valuable for measuring ignition or discharge voltages, as well as for measuring crosstalk between lines, and in electronic circuit design. In combination with min/max mode, the V p-p function allows the peak value of disturbances on a signal to be measured over an extended monitoring period.

### Capacitance Measurements

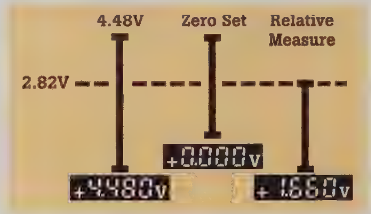
For measuring unknown devices or lead capacitances.



The PM 2525 capacitance function is unmatched in its class. The capacitance of any unknown device, or even of PCB tracks, can be measured directly in a wide range from 20 nF right up to 2000 µF, with a resolution of 1 pF.

### Simple Zero-Setting for Relative Measurements

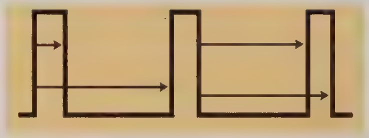
Direct measurement of tolerances or deviations from any preset value.



Zero-setting using any value for relative reference measurements is done simply with the PM 2525, simply by pressing the ZERO button. This principle allows tolerance measurements, or component deviations from specified values, to be measured directly, and eliminates the need to make all measurements as absolute values.

### Time and Frequency Measurements

Extra versatility through high-resolution time and frequency functions.

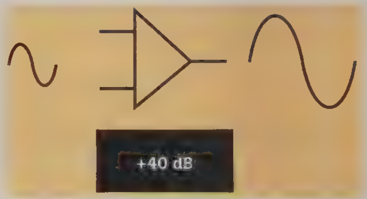


One of the PM 2525 extra measuring capabilities is a useful time function with a range of up to 100,000s and a maximum resolution of 10 µs. Freely programmable start and stop edges enable all periods and pulse width measurements to be made in a repetitive or single trigger mode. By measuring time and the number of zero crossings the frequency of the input signal is calculated. Two different frequency measurements are possible. In the normal mode there is a resolution of 1 Hz, but in the 'High resolution' mode a resolution of 0.1 Hz can be achieved. Maximum frequency is 20 MHz.

### Direct dB Read-Out

AC and dc voltages are shown as dB values to any zero reference level, with user programmable reference resistance.

This function allows V ac and V dc measurements to be readout directly as dB values, saving time-consuming calculations. dB measurements are made against an absolute or selectable zero reference level. It is also possible to program a different reference resistance.



Direct dB read-outs are essential for measurements on amplifier gains and losses, or on communications equipment. The dB function can also be used in conjunction with the zero-set mode for 'end-to-end' amplifiers measurements.

### Closed-Case, Electronic Calibration

The PM 2525 can be electronically calibrated and tested without opening the case, if the unit is equipped with an IEEE-488 or RS-232 interface. This function offers substantial time and cost savings and ensures that measurements are always made at optimum accuracy.

### Simple Command Structure

The PM 2525/53x can be used within a system via its IEEE-488 bus interface. In such a system, procedures are programmed using a simple command structure which eliminates complex codes by using straight-forward English statements.

To ease communication with both user and computer, the PM 2525 accepts numeric ranging values in either decimal or exponential notation, and automatically rounds-off to the correct range. To overcome the often lengthy and complex task of splitting the numerical data from the output string, the PM 2525 has an "OUT N" command by which only the numeric value is transferred.

## Specifications

### Technical Specifications

Accuracy specifications are valid for 23°C±5°C

# System/Bench Multimeters

## PM 2525 Digital Multifunctional Multimeter

### DC Voltage

Input Characteristics

| Range | Full Scale (Hi Res) | Resolution |  | Input Resistance |
|---|---|---|---|---|
|  |  | Norm | High |  |
| 200 mV | 210.000 mV | 10 µV | 1 µV | 20 MΩ |
| 2V | 2.10000V | 100 µV | 10 µV | 20 MΩ |
| 20V | 21.0000V | 1 mV | 100 µV | 11 MΩ |
| 200V | 210.000V | 10 mV | 1 mV | 10 MΩ |
| 2000V | 1000.00V | 100 mV | 10 mV | 10 MΩ |

**Accuracy:** ±(0.02% reading + 2 counts)
For High resolution multiply # of counts by 10
**Temperature Coefficient:** ±0.002% reading/°C

### Noise Rejection

| NMRR 50/60 Hz | Peak NM Signal | CMRR |  | Maximum CM Signal |
|---|---|---|---|---|
|  |  | DC | 50/60Hz |  |
| 80 dB | 2xRange | >120 dB | >120 dB | 250V rms |

**Maximum Input:** Hi to Lo, 1000V rms; Hi to Ground, 1000V rms; Lo to ground, 250V rms.

### AC Voltage

Input Characteristics

| Range | Full Scale | Resolution | Input Impedance |
|---|---|---|---|
| 200 mV | 210.00 mV | 10 µV | 20M/50 pF |
| 2V | 2.1000V | 100 µV | 20M/50 pF |
| 20V | 21.000V | 1 mV | 11M/80 pF |
| 200V | 210.00V | 10 mV | 10M/90 pF |
| 2000V | 750.00V | 100 mV | 10M/90 pF |

Inputs <1% of range are displayed as zero.
**Accuracy:** (4½ digits) ±(% reading + counts)

| Frequency | AC | AC+DC |
|---|---|---|
| 200 mV to 200V Ranges |  |  |
| 25 Hz-40 Hz | 0.6 + 40 | 0.8 + 60 |
| 40 Hz-100 Hz | 0.2 + 20 | 0.4 + 40 |
| 100 Hz-20 kHz | 0.8 + 40 | 1.0 + 60 |
| 20 kHz-50 kHz | 2.5 + 100 | 2.7 + 120 |
| 50 kHz-100 kHz | 4.0 + 100 | 4.2 + 120 |
| 2000V Range |  |  |
| 25 Hz-40 Hz | 0.6 + 40 | 0.8 + 60 |
| 40 Hz-70 Hz | 0.2 + 20 | 0.4 + 40 |

**Temperature Coefficient:** ±(0.03% reading + 1 count)/°C
**Maximum Input:** 750V rms or $10^7$ Volt-Hertz Product
**CMRR:** > 60 dB for 50/60 Hz
**Crest Factor:** 2 at Full Scale, increasing down scale by 2 × Full Scale/Reading

### DC Current

**Accuracy:** ±(0.1% reading + 5 counts)
**Temperature Coefficient:** ±(0.01% reading +0.5 count)/°C

### AC Current

**Accuracy:** ±(% reading + counts)

| Frequency | Range |  |
|---|---|---|
|  | 1µA to 100mA | 1A & 10A |
| 25 Hz - 40 Hz | 0.6 + 20 | 0.6 + 20 |
| 40 Hz - 200 Hz | 0.4 + 15 | 0.4 + 15 |
| 200 Hz - 500 Hz | 0.6 + 20 | 3.0 + 100 |

Between 5% and 100% of range
Measure Value <2% of range is displayed as 0
**Temperature Coefficient:** ±(0.04% reading +1.5 count)/°C

### Current

Input Characteristics

| Range | Full Scale | Resolution | Protection | Burden |
|---|---|---|---|---|
| 1 µA | 1.1000 µA | 0.1 nA | 250V rms | <2.5 mV |
| 10 µA | 11.000 µA | 1 nA |  | <2.5 mV |
| 100 µA | 110.00 µA | 10 nA |  | <40 mV |
| 1 mA | 1.1000 mA | 100 nA | Fused | <400 mV |
| 10 mA | 11.000 mA | 1 µA | 630 mAF | <40 mV |
| 100 mA | 110.00 mA | 10 µA | 250V rms | <400 mV |
| 1A | 1.1000A | 100 µA |  | <40 mV |
| 10A | 10.000A | 1 mA | – | <400 mV |

**Maximum Input:** 250V rms
**Maximum CM Voltage:** 250V rms, 350V peak

### Resistance

Input Characteristics

| Range |  | Full Scale | Resolution | Source Current |
|---|---|---|---|---|
| 4-Wire* | 2-Wire |  |  |  |
| 200Ω | 200Ω | 210.00Ω | 10 mΩ | 1 mA |
| 2 kΩ | 2 kΩ | 2.1000 kΩ | 100 mΩ | 1 mA |
| 20 kΩ | 20 kΩ | 21.000 kΩ | 1Ω | 100 µA |
| 200 kΩ | 200 kΩ | 210.00 kΩ | 10Ω | 10 µA |
| 2 MΩ | 2 MΩ | 2.1000 MΩ | 100Ω | 1 µA |
|  | 20 MΩ | 21.000 MΩ | 1 kΩ | 100 nA |
|  | 200 MΩ | 210.0 MΩ | 100 kΩ | 10 nA |

*Via Probe Input Only.
**Accuracy:** ±(% reading + counts)

| Range | Accuracy | Temp. Coeff |
|---|---|---|
| 200 | 0.1 + 10 | 0.01 + 1 |
| 2k |  |  |
| 20k |  |  |
| 200k |  |  |
| 2M | 0.5 + 10 | 0.05 + 2 |
| 20M |  |  |
| 200M | 3.0 + 20 | 0.5 + 2 |

**Open Circuit Voltage:** <4V
**Maximum Input Voltage:** 250V rms

### Peak Voltage

Input Characteristics

| Range | Resolution | Accuracy** |  | Max Slew Rate |
|---|---|---|---|---|
|  |  | DC & 25 Hz-20 kHz | 20-100 kHz |  |
| 2V | 1 mV | 1.0 + 10 | 5.0 + 10 | <2V/µs |
| 20V | 10 mV | 1.0 + 10 | 5.0 + 10 | <20V/µs |
| 200V | 100 mV | 1.0 + 10 | 5.0 + 10 | <200V/µs |
| 2000V* | 1 V | 1.0 + 1* | – | <0.5V/µs |

*Limited to maximum frequency of 60 Hz
**±(% reading + number of counts)

**Temperature Coefficient:** 0.15% reading/°C
**Measurement Time:** 500 ms
**Minimum Pulse Width:** 5 µs
**Maximum Volt-Hertz Product:** $10^7$
**CMRR:** >120 dB for dc, >60 dB for ac
**Maximum Input:** 600V rms, 850V - peak/peak

### Capacitance

| Range | Resolution | Accuracy % rdg + count | Temp. Coeff % rdg + count | Source Current |
|---|---|---|---|---|
| 20 nF | 1 pF | 1.0 + 20 | 0.1 + 2 | 100 nA |
| 200 nF | 10 pF | 1.0 + 20 | 0.1 + 2 | 1 µA |
| 2 µF | 100 pF | 1.0 + 20 | 0.1 + 2 | 10 µA |
| 20 µF | 1 nF | 1.0 + 20 | 0.1 + 2 | 100 µA |
| 200 µF | 10 nF | 1.0 + 20 | 0.1 + 2 | 1 mA |
| 2000 µF | 1 µF | 10.0 + 20 | 1.0 + 20 | 1 mA |

**Maximum Voltage at Input:** <2.5V
**Maximum Input Voltage:** 250V rms

### Diode

**Range:** 2000.0 mV
**Resolution:** 0.1 mV
**Source Current:** 1 mA
**Maximum Input Voltage:** 250V rms

### Continuity

**Source Current:** 1 mA
**Short Circuit:** Audible Tone (0 to 10Ω)
**Open Circuit:** No Tone (>10Ω)

### Temperature*

**Range:** −100°C to 850°C
**Resolution:** 0.1°C
**Accuracy:** ±(0.3% reading + 0.3°C)
**Temperature Coefficient:** ±(0.03% reading + 0.03°C)/°C
**Source Current:** 1 mA
**Linearization:** Probe characteristic is linearized within limits stated by DIN 43760.

* An additional PM 9248/01 Temperature Probe or Pt100 element is required

### dB Measurements

**0dB Reference:** 1 mW (Rref 600Ω)
**Rref:** Programmable from 0.1 mΩ to 9999Ω
**Resolution:** 0.1 dB (1 dB if < 1 mV)
**CMRR:** >120 dB for dc Signals

# PM 2525 Digital Multifunctional Multimeter

## DC Ranges

| Input Voltage | dBm 600 Ohm | Range | Accuracy |
|---|---|---|---|
| 0.1 mV to 1 mV | −77 to −57 | 200 mV | 1 dB |
| 1 mV to 200 mV | −57.7 to −11.7 | 200 mV .1 dB | 1 dB (<5 mV) (>5 mV) |
| 200 mV to 2V | −11.7 to 8.2 | 2V | 0.1 dB |
| 2V to 20V | 8.2 to 28.2 | 20V | |
| 20V to 200V | 28.2 to 48.2 | 200V | |
| 200V to 1000V | 48.2 to 62.2 | 2000V | |

## AC Ranges

| Input Voltage | dBm 600 Ω | Range | Accuracy 25 Hz 20 kHz 100 kHz | |
|---|---|---|---|---|
| 2mV to 6mV | −51.7 to −42.2 | 200 mV | Not Specified | |
| 6 mV to 18 mV | −42.2 to −32.6 | | 0.8 dB | Not Specified |
| 18 mV to 200 mV | −32.6 to −11.7 | | 0.1 dB | 1 dB |
| 200 mV to 2V | −11.7 to 8.2 | 2V | | |
| 2V to 20V | 8.2 to 28.2 | 20V | | |
| 20V to 200V | 28.2 to 48.2 | 200V | | |
| 200V to 750V | 48.2 to 62.2 | 2000V | Not Specified | |

## Frequency

### Input Characteristics

| Range | Full Scale (Hi Res) | Resolution Norm | Resolution High | Accuracy* |
|---|---|---|---|---|
| 10 kHz | 10.0000 kHz | 1 Hz | 0.1 Hz | 0.01 + 2 |
| 100 kHz | 100.000 kHz | 10 Hz | 1 Hz | 0.01 + 2 |
| 1 MHz | 1.00000 MHz | 100 Hz | 10 Hz | 0.01 + 2 |
| 10 MHz | 10.0000 MHz | 1 kHz | 100 Hz | 0.01 + 2 |
| 20 MHz | 20.000 MHz | 10 kHz | 1 kHz | 0.01 + 2 |

*±(% reading + number of counts)

**Temperature Coefficient:** ±0.001% reading/°C
**Coupling:** AC
**Sensitivity:** 10 Hz to 100 Hz, 1V peak; 100 Hz to 10 MHz, 250 mV peak; 10 to 20 MHz, 500 mV peak.
**Maximum Input Voltage:** 250V rms

## Time

### Input Characteristics

| Range | Full Scale | Resolution Norm | Accuracy ±(% Rdg) | Temp. Coeff ±(% Rdg)/°C |
|---|---|---|---|---|
| 1s | .99999s | 10 µs | 0.01 | 0.001 |
| 10s | 9.9999s | 100 µs | 0.01 | |
| 100s | 99.999s | 1 ms | 0.01 | |
| 1000s | 999.99s | 10 ms | 0.01 | |
| 10000s | 9999.9s | 100 ms | 0.01 | |
| 100000s | 99999s | 1s | 0.01 | |

## Measurement Response Times*

| Function & Range | Ranging No | Ranging Yes |
|---|---|---|
| DC Voltage | 0.8 | 1.5 |
| AC Voltage | 1.5 | 3.0 |
| DC Current | 0.8 | 2.5 |
| AC Current | 1.5 | 3.0 |
| Resistance 200 to 200 kΩ | 0.8 | 2.5 |
| Resistance 2M & 20 MΩ | 2.0 | 3.5 |
| Resistance 200 MΩ | 9.0 | 10.0 |
| Peak Voltage | 1.0 | 2.5 |
| Peak/Peak Voltage | 1.5 | 5.0 |
| Capacitance | 1.0 | 1.5 |
| Diode | 0.8 | - |
| Continuity | <0.15 | - |
| Temperature | 0.5 ** | - |
| dB (DC Mode) | 1.5 | - |
| dB (AC Mode) | 3.0 | - |
| Frequency (10 kHz) | 1.5 | - |
| Frequency (10 kHz - 20 MHz) | 0.3 | 0.5 |

* All times expressed in seconds for normal measurement speed
** Excluding probe response time

## Battery Option

**Operating Time (Full Charge):** >5 Hours
**Charge Time:** <15 Hours
**Low Battery Indication:** On Display

## GPIB/IEEE-488 Interface

Allows complete control and data output capability and supports the following interface function subsets: SH1, AH1, T5, SR1, RL1, DC1, DT1.

## RS-232C Serial Interface

**Baud Rates:** 110 to 9600
**Stop Bits:** 1 or 2
**Data Bits:** 7 or 8
**Parity:** Odd, Even or None

## Analog Output

Allows selective monitoring of part of the display.
**Output Voltage:** 0 to 1V
**Accuracy:** ±0.25% of reading ± 0.25% of range
**Temperature Coefficient:** ±(0.025% reading + 0.01% range)/°C
**Output Resistance:** 200Ω

## General Specifications

**Temperature Range:** 0 to 40°C operating; -40°C to +70°C Storage
**Humidity:** 20% to 80% non condensing
**Power:** 98V to 129V, 60 Hz or 196V to 258V 50 Hz; 12 VA Max
**Safety:** IEC 348 Class II
**Calibration Interval:** 1 Year
**Size:** 8.6 cm H × 21.0 cm W × 28.7 cm D (3.4 in H × 8.4 in W × 11.3 in D) 10.6 cm H (including Feet)
**Weight:** 2.5 kg (5.5 lb)

## Ordering Information

### Models

**PM 2525/03n** Basic Digital Multimeter ***$1100***
**PM 2525/23n** DMM with Battery Pack ***$1325***
**PM 2525/53n** DMM with IEEE-488 Interface ***$1450***
**PM 2525/63n** DMM with RS-232C Interface ***$1330***
**PM 2525/73n** DMM with Analog Output ***$1660***

The **n** indicates the required line cord. To select your line cord substitute the **n** by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

**Included with Instrument**
One-year product warranty, test leads and operator manual.

### Accessories

**PM 2193/03** 19" Rack Mount Kit ***$325***
**PM 2194/02** Blank Panels for PM 2193 ***$105***
**83RF** High Frequency Probe ***$89***
**PM 9244** AC/DC Current Shunt ***$105***
**PM 9245** AC Current Transformer ***$105***
**PM 9249/01** Pt 100 Temperature Probe ***$220***
**PM 9264/01** 4-Wire Resistance Measurement Cable ***$130***
**PM 9266/04** Safety Test Leads with Probes ***$43***
**PM 9267/01** Data Hold Probe ***$215***

### Manuals

**PM 2525** Operator* P/N 906057 ***$55.00***
**PM 2525** Programming Card P/N 856278 ***$5.00***

*No charge with purchase of unit

### Customer Support Services

### Factory Warranty

One-year product warranty.

# Digital Voltmeters

## 8920A, 8921A & 8922A Wideband Digital Voltmeters

INPUT
700 V RMS MAX
10 MΩ
<30 pF
FUNCTION
RANGE
DISPLAY
dBm REFERENCE (Ω)
POWER
AC+DC DAMPING
AC
FILT IN
OUT
HOLD
AUTO
STEP UP
dB
REL
VOLTS
dBm
RELATIVE REFERENCE
FLUKE 8922A TRUE RMS VOLTMETER

8922A

- True-rms ac with read-out in volts or dB
- AC or ac + dc measurements
- Autoranging
- Selectable dBm reference impedance
- Analog display for peak/null adjustments
- Rear panel linear analog output (Models 8920A & 8922A)
- Relative dB measurements
- 10 Hz to 20 MHz or 2 Hz to 11 MHz (Model 8922A)
- 180 µV to 700V

### Choice of Bandwidth

Bandwidth capabilities of the 8920 Series Voltmeters encompass many applications, from testing high-frequency oscillators, attenuator flatness and amplifier frequency response to microphone levels, phono-pickup devices, vibration tests and wideband noise levels to list only a few. Models 8920A and 8921A cover a bandwidth of 10 Hz to 20 MHz. The 8922A offers low-frequency capabilities in the 2 Hz to 11 MHz bandwidth and a switchable 200 kHz low pass filter which eliminates unwanted high-frequency noise from the measured signal.

### True-RMS Converter

The heart of all 8920 Series Voltmeters is Fluke's monolithic thermal converter which can measure rms values of an ac signal. This patented semiconductor circuit balances the heating power of a dc feedback signal against the heating power of the ac input voltage, producing a true rms equivalent dc output. This unique converter enables Fluke voltmeters to provide wideband, low-noise, accurate measurements at a low cost.

### Selectable dBm Reference Impedance

Fluke's 8920 Series Voltmeters permit an operator to select any one of 12 reference impedances from 50Ω to 1200Ω and to digitally read out dB values referenced to the selected level. Input impedance is constant at 10 MΩ for all settings of the dB reference control. This minimizes circuit loading and allows the operator to add the appropriate termination externally. Zero dB corresponds to 1 mW for each of the selectable levels.

### AC or AC + DC Functions

The input coupling capabilities of the 8920 Series Voltmeters help solve difficult measurement problems. Without these features, whenever an operator is required to measure a signal which (1) is not symmetrical, (2) has unequal excursions above and below zero, or (3) has a dc component, it is necessary to go through a series of computations to determine the actual rms voltage value. First, the signal has to be measured with a dc voltmeter (providing its ac rejection is sufficient) and then with an ac voltmeter. Finally, the sum of the squares of the two readings must be calculated and the square-root extracted from the result. Failure to consider the dc component by using only an ac-coupled meter can result in substantial error.

### Relative dB Measurements

The relative reference feature of the 8920 Series Voltmeters allows direct readings of gain or attenuation. Depressing the REL switch sets the existing dB reading to zero, establishing the input voltage level as the relative dB reference. Subsequent readings of higher voltages will be displayed as +dB, lower voltages as −dB.

### Autoranging

Fluke's autoranging feature allows you to carry out your testing without having to change ranges manually. A range can be placed on HOLD or manually stepped up to a higher range. On HOLD, the meter will remain in a given range regardless of changes in input levels. On STEP UP, the meter will increase ranges step-by-step until the switch is released.

### Peaking/Dipping Meter

In addition to an accurate digital display, all Fluke voltmeters in the 8920 Series feature an analog meter for peak and null voltage adjustments. The meter indicates 0 to 100 percent full scale in each range.

### Linear Analog Output

Models 8920A and 8922A are equipped with a rear panel output for driving X-Y or strip chart recorders, delivering voltages proportional to the display count. A 2-volt level equals 2000 counts, a 1-volt level equals 1000 counts, etc. This feature is not available on Model 8921A.

### Accuracy

Fluke digital voltmeters avoid the possibilities for error so common in analog meters. The digital displays eliminate the likelihood of misreading the meter due to viewing angle problems of parallax common with analog meters. Also, the accuracy of 8920 Series Voltmeters is specified as a percent of reading rather than as percent of full scale.

Percent of reading accuracy does not degrade for measurements at the low end of a scale. Front panel switching offers a choice of readings in dB or volts.

## Specifications

### Technical Specifications

The accuracy specifications below apply from 9% to 100% of full scale and from 18°C to 28°C for 90 days. For six-month specifications multiply figures by 1.5.

# 8920A, 8921A & 8922A Wideband Digital Voltmeters

## Option Specifications

### Counter Output Option (−03)

Drives frequency counters. Converts input signal into a 100 mV peak square wave. Greater dynamic range extends the sensitivity of counters to 180 µV at the low end and 700V at the high end. Impedance is 50Ω. Used with the 8921A, counter can measure signals elevated to 500V rms.

### Logarithmic Analog Output Option (−04)

For 8920A and 8922A only. Provides an analog output voltage proportioned to the logarithm of the input voltage. Plots logarithmically-scaled graphs, dB variations. Zero volts and zero dB on the output correspond with 200 µV on input. A 13.1V output corresponds to 700V or 131 dB on the input. Therefore, 2V on the output equals 20 dB, 6V equals 60 dB, etc., making it easy to relate voltage to dB. The option provides a low-cost way of using an X-Y recorder to plot graphs as one continuous curve over any part of the 131 dB range.

### PTI Interface Option (−521)

To use the 8920 Series DVMs with Fluke's own addressable Portable Test Instrument (PTI) byte-serial data bus. Output to Fluke printers, typically. Supplied with 2-foot ribbon cable Y7203.

### 1120A Interface Option (−522)

A "personality card" that fits in the Fluke 1120A GPIB/IEEE-488* Translator.

### IEEE-488 Interface Option (−529)

The 8920 Series Voltmeters can be made compatible with IEEE Std 488-1978 by using Option −529 in combination with the Fluke Model 1120A Translator. A single 1120A will interface three Fluke instruments to the bus. Option −529 is electrically equivalent to Option −521 plus Option −522. Supports subsets SH1, AH1, T3, TE3.

**AC+DC Accuracy:** Add to ac accuracy specifications (above) ±10 digits or ±0.5 dB above 2 mV, or ±100 digits or ±5.0 dB below 2 mV. For dc only, add above digits to 50 Hz to 10 kHz specifications.

**Functions:** True-rms measurements only. AC or ac + dc (8920A and 8921A); ac or ac + dc with damping (8922A)

**Maximum Input:** 700V rms or 1000V peak, not to exceed a volt-hertz product of 1 × 10⁸ on any range

**Maximum Common Mode Voltage:** 400 mV rms or 600 mV peak (8920A & 8922A); 500V rms or 700V peak (8921A)

**AC Common Mode Rejection:** ≥60 dB at 50 and 60 Hz with 100Ω unbalance

**DC Common Mode Rejection:** ≥100 dB, 100Ω unbalance

**Crest Factor:** 7 at full scale, increasing down scale by 7 times the voltage range divided by the voltage input. Degrades below 10 Hz, annunciated when capability exceeded (8922A only).

**Input Impedance:** 10 MΩ shunted by <30 pF

**Voltage Ranges:** 2 mV, 20 mV, 200 mV, 2V, 20V, 200V, 700V

**Ranging:** Autoranging with HOLD to defeat auto ranging and STEP UP for manual ranging. Ranges up at 2000 counts and ranges down at 180 counts.

**Decibel Ranges:** In the autorange mode, the instrument appears as though it has a single range spanning 131 dB

**dBm Reference:** Twelve user-selectable impedances are provided to reference a 0 dBm, 1 mW level (50Ω, 75Ω, 93Ω, 110Ω, 124Ω, 135Ω, 150Ω, 300Ω, 600Ω, 900Ω, 1000Ω, and 1200Ω) (dBV = 1000Ω)

**Relative dB Reference:** A voltage input present when this button is pushed is held as "0 dB" reference point. Subsequent readings indicate ± deviations from this point.

**Voltage Resolution:** 0.05% of ranges (3½ digits)

**Decibel Resolution:** 0.01 dB (4 digits)

**Typical -3 dB Points:** 40 MHz on 20 mV thru 20V ranges and 4 MHz on 2 mV range (8920A/ 8921A); 22 MHz on 2 mV to 20V ranges (8922A)

**Low Pass Filter:** Approximately 200 kHz - 3 dB point (8922A)

**Reading Rate:** 2.5/s or 1/s with ac + dc with damping (8922A)

**Autorange Rate:** <950 ms or <3.5s with ac + dc with damping (8922A)

**Response Time:** (To rated accuracy) <1.6s or <7s with ac + dc with damping (8922A)

**Readout:** Panel-selectable for volts or dB, automatic decimal point location: analog peaking/ dipping meter

**LED Annunciators:** Indicate "mV," "V," "dB," "REL REF," and "2 MHz MAX" for 2 mV range (8920A and 8921A) and

**AC Accuracy:** ± % of voltage reading or ± dB (8920A & 8921A)

| Range | 2 Hz | 10 Hz | 20 Hz | 50 Hz | 10 kHz | 200 kHz | 1 MHz | 2 MHz | 10 MHz | 20 MHz |
|---|---|---|---|---|---|---|---|---|---|---|
| 700V<br>200V | Not Speci-fied | 5% or 0.5 dB | 1% or 0.15 dB | 0.5% or 0.1 dB | | 0.7% or 0.15 dB | Not Specified | | | |
| 20V<br>2V<br>200 mV | | | | | | | 3% or 0.35 dB | | 5% or 0.5 dB | |
| 20 mV | | | 2% or 0.245 dB | 1% or 0.15 dB | | 2% or 0.25 dB | 4% or 0.4 dB | | | |
| 2 mV | | | 3% or 0.35 dB | 2% or 0.25 dB | | 3% or 0.35 dB | | | | |

**AC Accuracy:** ± % of voltage reading or ± dB (8922A)

| Range | 2 Hz | 10 Hz | 20 Hz | 50 Hz | 10 kHz | 200 kHz | 1 MHz | 2 MHz | 11 MHz |
|---|---|---|---|---|---|---|---|---|---|
| | FILTER IN | | | | FILTER OUT | | | | |
| 700V<br>200V | 3% or* 0.35 dB | 1% or* 0.15 dB | 1% or 0.15 dB | 0.5% or 0.1 dB | | 0.7% or 0.15 dB | Not Specified | | |
| 20V<br>2V<br>200 mV | | 5% or 0.5 dB | | | | | 3% or 0.35 dB | 5% or 0.5 dB | |
| 20 mV | 5% or 0.5 dB | 2% or* 0.25 dB | 2% or 0.25 dB | 1% or 0.15 dB | | 2% or 0.25 dB | | | |
| 2 mV | 5% or* 0.5 dB** | 5% or 0.5 dB | 3% or 0.35 dB | 2% or 0.25 dB | 4% or 0.4 dB | | | | |

* Valid when AC + DC DAMPING is selected and input has no dc components

** Below 2 mV add number of digits (N) to ±5% voltage readings, where N = 5 ÷ mV input. Or, for dB readings, add N to ±0.5 dB, where $N = 0.5 \div (\text{mV input})^2$.

## 8920A, 8921A & 8922A Wideband Digital Voltmeters

"UNCAL" when crest factor limitation exceeded (8922A)
**Overrange:** Flashes maximum reading for that range
**Underrange:** Flashes decimal
**Linear Analog Output:** (8920A and 8922A only) Linear output of 2000 mV dc for a 2000-count readout; ±1.0% relative to display; essentially 0Ω output into a ≥10 kΩ load; non-isolated, with output common same as input common

### General Specifications

**Temperature:** -40°C to +75°C, non-operating
**Relative Humidity:** <80%
**Shock:** MIL-T-28800 all classes
**Vibration:** MIL-T-28800, classes 2, 3 & 4
**MTBF:** >10,000 hours
**Safety:** Designed to comply with ANSI C39.5, CSA Bulletin 556B, and FM 3820
**Power:** 100V, 120V, 220V ac ±10% or 240V ac +4%, -10%, selected by internal switches, 50 to 400 Hz, 10W max
**Size:** 32.6 cm L × 20.3 cm W × 10.5 cm H (12.9 in L × 8.0 in W × 4.3 in H)
**Weight:** 2.47 kg (5.44 lb)

## Ordering Information

### Models

| | | |
|---|---|---|
| **8920A** | DVM w/BNC Input | ***$3100*** |
| **8921A** | DVM w/Banana Jack Input | ***$3100*** |
| **8922A** | DVM w/BNC Input | ***$3255*** |

### Included with Instrument

One-year product warranty, line cord, Instruction manual, and Certificate of Calibration Practices.

### Options

| | | |
|---|---|---|
| **-003** | Counter Output | ***$420*** |
| **-004*** | Logarithmic Output (not for 8921A) | ***$360*** |
| **-521** | Interface Opt w/PTI Cable | ***$355*** |
| **-521K** | Interface Opt w/PTI Cable, field-installable | ***$380*** |
| **-522K** | 1120A Interface field-installable | ***$315*** |
| **-529**** | IEEE-488 Interface Option w/PTI Cable | ***$595*** |

*Not compatible with –521, –521K, –529
**The –529 Option can be ordered and installed at time of manufacture only. For existing instruments which do not have –529 Option installed, an IEEE Interface can be added by ordering –521K and –522K (1120A required).

### Accessories

| | | |
|---|---|---|
| **1120A** | IEEE-488 Translator | ***$1080*** |
| **Y7203** | Ribbon Cable, PTI 2 ft | ***$70*** |
| **Y7204** | Ribbon Cable, PTI 5 ft | ***$80*** |
| **A90** | Current Shunt, 6-Range | ***$990*** |
| **80J-10** | Current Shunt, 10 Amp | ***$65*** |
| **Y9100** | BNC 50Ω Attenuator (6 dB) | ***$120*** |
| **Y9101** | BNC 50Ω Attenuator (14 dB) | ***$120*** |
| **Y9102** | BNC 50Ω Attenuator (20 dB) | ***$120*** |
| **Y9103** | 50Ω Feedthrough Terminator | ***$75*** |
| **Y9107** | BNC "T" | ***$35*** |
| **Y9109** | Banana to BNC Adapter | ***$40*** |
| **Y9112** | BNC to BNC Cable, 6 ft | ***$35*** |

### Manuals

| | | |
|---|---|---|
| **8920/21A** | Instruction* | ***$45*** |
| **8922A** | Instruction* | ***$45*** |

*No charge with purchase of unit.

### Customer Support Services

**Factory Warranty**
One-year product warranty.

# Handheld Multimeters

## Series 18 Handheld Multimeters

High resolution analog bargraph
Logic measurements to 10 MHz
Frequency measurements to 200 kHz
Min/Max and data hold
mAs option for medical applications
Electronic closed-case calibration
750V ohms protection
0.1%, 0.07% and 0.04% basic accuracy
Backlight LCD option

+ 4.964 V
PM 2518 rms multimeter PHILIPS
FUNCTION

PM 2518

### Benchtop Performance in Handheld Size

The Series 18 DMMs are portable and compact, convenient for use in the laboratory or field, yet with all the performance and features expected of benchtop instruments.

The range of three models allows you to select exactly the functions you need for your application and environment, from general purpose testing, through communications and digital measurements, right up to R&D. Series 18 DMMs offer an excellent combination of value, convenience and performance.

### High Accuracy Display

The 4+ digit display permits fast, high resolution measurements to be made on all functions. For example, 5V is measured to the nearest millivolt, with an accuracy of 0.1% or better.

### AC True RMS Values, Accurate up to 100 kHz

The Series 18 DMMs have a custom true rms converter that guarantees accurate measurements on all ac signals (ac coupled). The following table compares the readings given for various input waves for the Series 18 meters and standard averaging instruments.

| Signal Form | ∿ | ⊓ | ⋀ | ⋏ |
|---|---|---|---|---|
| RMS | 5V | 5V | 5V | 5V |
| Reading on Series 18 % error | 5V<br>0 | 5V<br>0 | 5V<br>0 | 5V<br>0 |
| Reading on averating meter % error | 5V<br>0 | 5.55V<br>11 | 4.75V<br>6 | 3.2V<br>36 |

### 750V Protection for Reliability

With standard 750V input protection on all modes except current, the Series 18 handheld meters have excellent protection against accidental overload.

They can be connected to three-phase power supplies and the function switch can be rotated through the ohms range without damaging the meter.

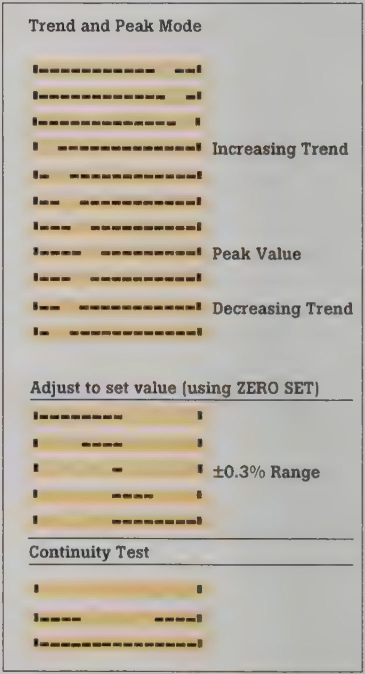
Standard dc and ac voltage range is 1 kV, protected to withstand 2.5 kV spikes, ensuring that these meters are not damaged in tough measuring conditions.

### Bargraph Display

In checking signal trends or looking for peak values, the Series 18 bargraph display is a step forward over conventional analog pointer systems. For example, as long as the input signal is increasing, the rotating bargraph moves to the right. When autoranging of the digital display value occurs, the bargraph continues to move to the right, always giving a clear indication of the signal trend, even when the signal crosses meter ranges.

For accurate detection of peak values, for example, when tuning communication equipment, the bargraph has a maximum resolution equivalent to 8 counts on the digital display, or 0.08% of an analog scale.

For adjustment to set values, the ZERO SET mode of the Series 18 meters allows the bargraph to function as a highly sensitive minus-null-plus indicator. This allows accurate analog-indicated settings to any value within the meter's measuring range to an accuracy of 0.3%. And continuity testing not only gives an audible warning, but also a visual indication on the bargraph display.



# Handheld Multimeters

## Series 18 Handheld Multimeters

### Choice of Models

**PM 2518**

- AC true rms (ac-coupled)
- 750V ohms protection
- Analog bargraph
- Closed-case calibration
- Relative measurements
- dB measurements
- Temperature measurements
- 0.1% dc accuracy
- 40 kHz range

**PM 2618**

All PM 2518 features plus . . .

- 0.07% dc accuracy
- 70 kHz ac range
- 200 kHz counter
- 10 MHz logic detection
- mAs option

**PM 2718**

All PM 2618 features plus . . .

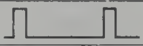
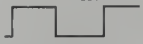
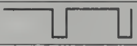
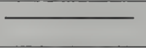
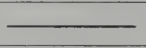
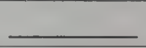
- 0.04% dc accuracy
- 100 kHz ac range
- Min/Max measurements
- Data capture and hold

### Added Features

#### 10 MHz LOGIC Detection
**(PM 2618 and PM 2718 only)**

Digital signal activity at speeds of more than 10 MHz can be meaningfully indicated by the LOGIC function. This allows not only high, low, bad or pulsed logic levels to be detected, but also gives an indication of the duty cycle at the measured point. The ability to distinguish between bad levels and real open circuits considerably reduces troubleshooting time.

At 'any logic,' compatibility is simply achieved by connecting the measuring leads to the low and V cc levels in the circuit to be tested, and pressing the ZERO button. The thresholds for the LOGIC mode are then set to 25% (low) and 75% (high) of this value, thereby covering the full range of logic levels – from low-power CMOS to industrial hardwired logic.

| Input | Display |
|---|---|
|  | HOLD - n - - PROBE |
|  | HOLD nnnn PROBE |
|  | HOLD - u - - PROBE |
|  | - - - -<br>HOLD PROBE |
|  | HOLD bAd PROBE |
|  | HOLD - - - - PROBE |
| Open Circuit | HOLD OPEn PROBE |

#### mAs Version (PM 2618 only)*

Where milliamp second measurements are required, for example in medical environments, the PM 2618/323 version allows these to be made in addition to any other standard functions. A single switch allows selection of mA, mAs measure or mAs zero. Measurement of pulses from 0.5 ms to 1s in the range 10 μAs to 20 As ensures compatibility with current and future X-ray systems and scanners. This special version also includes the backlight display, with automatic on/off switching depending on the ambient light level.

#### Resistance Measurements from Short Circuit to 100 MΩ

Fast circuit-continuity checks are possible with a beeper that gives an instant warning of short-circuits, while resistance values from 100 mΩ to 100 MΩ are displayed clearly and with optimum resolution via the autoranging.

#### Easy to Read in the Dark

Where measurements have to be made under poor lighting conditions, for example among tightly packed equipment or in out-of-the-way areas, special backlight versions of the new Series 18 DMMs have a display light that switches on automatically. If no new measurement is made, the backlight switches off after a short period to conserve battery life. Complete power-down of the instrument takes place after 30 minutes on both standard and backlight versions. Combined with low power consumption in normal use, this contributes to a battery lifetime of hundreds of hours.

#### Direct Temperature Readings

The optional PM 9249 Platinum RTD 100 probe gives direct temperature readings from −60°C to +200°C, with a resolution of 0.1°C for air, liquid or surface temperatures.

#### Direct Gain and Loss Measurements

Measurements on amplifiers or communications equipment frequently require the conversion of readings into dB values. This is available with a single button operation on the Series 18, to a resolution of 0.1 dB and eliminating the need for separate calculations.

#### Relative Reference Values

Measurements of tolerances or component deviations from specified values are simple with the Series 18. A reference relative value can be set using the ZERO button, so the user does not always have to make the measurement relative to zero and calculate the deviation. Measurements are then made automatically, relative to that reference value.

#### 200 kHz Frequency Counter Function (PM 2618, PM 2718 only)

An automatic counter function works at frequencies from 1 Hz to 200 kHz. Readout is direct, with a scale indication showing Hz or kHz. It is highly sensitive, making it suitable for audio applications.

#### MIN/MAX Readout (PM 2718 only)

To monitor minimum and maximum levels in test set-ups, all the user has to do is connect the PM 2718 and begin measuring. Minimum and maximum readings can be recalled and displayed at any time; and maximum and minimum readings of low-frequency signals (±1Hz) can be measured and read within a few seconds.

#### Data Capture and Hold

The PM 2718 data capture function allows a measured value to be frozen on the display, essential when working in situations where access to the measurement point is difficult. The PM 2718 offers this as standard and it is optionally available on all Series 18 instruments with the data hold probe PM 9267. The user simply connects the measuring leads, waits for the "beeper" to confirm that the measurement has been acquired, and it can be read whenever it is needed.

#### Closed-Case Calibration

The Series 18 DMMs are the first compact battery-powered units to offer closed-case calibration, a capability normally found only on much more expensive instruments. This facility allows savings in calibration time and cost and ensures error-free calibration.

## Specifications

### Technical Specifications

**Display:** LCD, 12 mm height with range and message characters
**A/D Conversion System:** Delta modulation, auto-zeroing, 11,000 counts
**Reading Rate:** 2.5 measurements/s
**CMRR DC:** >100 dB
**CMRR 50/60 Hz:** >80 dB
**SMRR 50/60 Hz:** >60 dB
**Ranging:** Fully automatic except 100 MΩ
**Range Selection:** Autorange up at 110% of fs; autorange down at 10% of fs; manual ranging by key
**Overload:** Indicated by OL on display
**Underload (dB):** Indicated by UL on display
**Crest Factor Overload:** Indicated by on display
**High Voltage 110V:** Indicated by on display
**Max V × Hz:** $10^7$

# Handheld Multimeters

## Series 18 Handheld Multimeters

### Logic Function (PM 2618 and PM 2718)

V cc of test unit entered by use of ZERO key on meter
**Default V cc:** 3.2V (gives 0.8V and 2.4V)
**Logical 0 Level:** ≤0.25V cc
**Logical 1 Level:** ≥0.75V cc
**Threshold Resolution:** ±50 mV
**Max V cc:** 100V
**Min Pulse Duration:** 100 ns using 1:1 probe
**Max Frequency:** 10 MHz using 1:1 probe (above 10 kHz)
**Beeper Function:** On/off via FUNCTION key; low tone for logical 0; high tone for logical 1; intermittent high tone for pulse
**Relative Measurement** (using ZERO button)
**Applicable Functions:** All
**Set Reference:** On pushing ZERO button, last displayed value is used as reference
**Recall Reference:** By pushing and holding ZERO
**Clear Reference:** By key combination or autorange selection

### BEEPER Functions

**PM 2518 and PM 2618:** Dual tone selectable for ohms; low ≤10%, high ≤ continuity; low ≤10%, high ≤1% logic; see logic function
**PM 2718:** As PM 2618 plus data captured indication

### mAs Measurement

**Ranges:** 20 mAs, 200 mAs, 2 As, 20 As
**Maximum Input Current on 20A Socket:** 10A continuous, 20A for 20s
**Resolution:** 10 µAs in 20 mAs range
**Number of Representation Units:** 2200
**Accuracy:** ±(1% of reading +0.3% of range) covering 3% to 100% of range
**Temperature Coefficient:** ±(0.06% of reading +0.06% of range)
**Drift:** <2 digits/s
**Min Pulse Width:** 0.5 ms
**Max Pulse Width:** 1s
**Voltage Drop Over Shunt:** 20 mAs, 2 As range, <25 mV at 20 mA resp 2A; 200 mAs, 20 As range, <250 mV at 200 mA resp 20A
**Voltage Drop Over Input Sockets:** 20 mAs, 2 As range, <100 mV at 20 mA resp 2A; 200 mAs, 20 As range, <1V at 200 mA resp 20A
**Protection:** 250V rms ranges, 20 mAs; range 2 As, 20 As not protected; max current 20A for 20s
**Max Common Mode Voltage:** 400V
**Zero Setting Integration:** By switching the ERASE knob

| Function | Meter Ranges | Resolution | Accuracy (% reading + % range) | | | Input characteristics | Response Time | Overload Protection | Notes |
|---|---|---|---|---|---|---|---|---|---|
| | | | PM 2518 | PM 2618 | PM 2718 | | | | |
| V dc | 1V<br>10V<br>100V<br>1000V | 100 µV<br>1 mV<br>10 mV<br>100 mV | 0.1 + 0.02<br>0.1 + 0.02<br>0.1 + 0.02<br>0.1 + 0.02 | 0.07 + 0.02<br>0.07 + 0.02<br>0.07 + 0.02<br>0.1 + 0.02 | 0.04 + 0.02<br>0.04 + 0.02<br>0.04 + 0.02<br>0.1 + 0.02 | 10 MΩ<br>10 MΩ<br>9.1 MΩ<br>9.1 MΩ | Manual <1s<br>Auto <1.5s | 1000V rms<br>2.5 kV spike | |
| V ac (ac coupled, True rms, crest factor 2) | 1V<br>10V<br>100V<br>1000V | 100 µV<br>1 mV<br>100V<br>1000V | 40 Hz to 3 kHz<br>0.5 + 0.1<br>3 kHz-40 kHz<br>per kHz 0.20 + 0.05 | 40 Hz to 3 kHz<br>0.4 + 0.1<br>3 kHz-70 kHz<br>per kHz 0.15 + 0.03 | 40 Hz to 3 kHz<br>0.3 + 0.1<br>3 kHz-100 kHz<br>per kHz 0.1 + 0.03 | >2 MΩ<br><20 pF | Manual <1s<br>Auto <1.5s | 1000V rms<br>2.5 kV spike | |
| I dc | 20 mA<br>200 mA<br>2A<br>10A<br>(20A<20s) | 10 µA<br>100 µA<br>1 mA<br>10 mA | 0.5 + 0.1<br>0.5 + 0.1<br>0.5 + 0.1<br>0.5 + 0.1 | 0.4 + 0.1<br>0.4 + 0.1<br>0.4 + 0.1<br>0.4 + 0.1 | 0.4 + 0.1<br>0.4 + 0.1<br>0.4 + 0.1<br>0.4 + 0.1 | <25 mV drop<br><250 mV drop<br><25 mV drop<br><250 mV drop | Manual <1s<br>Auto <1.5s | 20 mA and 200 mA ranges fuse protected | Voltage drop excludes fuse on 20 mA and 200 mA ranges |
| I ac (ac coupled True rms, crest factor 9) | 20 mA<br>200 mA<br>2A<br>10A<br>(20A<20s) | 10 µA<br>100 µA<br>1 mA<br>10 mA | 0.06 + 0.3<br>40 Hz-400 Hz | 0.6 + 0.3<br>40 Hz-400 Hz | 0.4 + 0.3<br>40 Hz-400 Hz | Voltage drop as I dc | Manual <1s<br>Auto <2 | as I dc | as I dc |
| R | 1 kΩ<br>10 kΩ<br>100 kΩ<br>1 MΩ<br>10 MQ<br>100 MΩ | 100 mΩ<br>1Ω<br>10Ω<br>1 MΩ<br>1 kΩ<br>100 kΩ | 0.3 + 0.1<br>0.3 + 0.1<br>0.3 + 0.1<br>0.3 + 0.1<br>0.5 + 0.1<br>5 + 3 | 0.2 + 0.1<br>0.2 + 0.1<br>0.2 + 0.1<br>0.2 + 0.1<br>0.4 + 0.1<br>5 + 3 | 0.15 + 0.05<br>0.15 + 0.05<br>0.15 + 0.05<br>0.15 + 0.05<br>0.3 + 0.1<br>5 + 3 | 1 mA drive<br>100 µA drive<br>10 µA drive<br>1 µA drive<br>100 nA drive<br>10 nA drive | Manual <1s<br>Auto <3s<br>10s | 750V | Open input Voltage 3V<br>100 MΩ Manual ranging |
| Hz PM 2618 and PM 2718 only | 20 kHz<br>200 kHz | 1 Hz<br>10 Hz | N.A.<br>N.A. | 0.1<br>0.1 | 0.1 + 0.01<br>0.1 + 0.01 | ≤1V p-p sensitivity<br>2 MΩ//3pF | | | 10 Hz lower limit<br>Gate time 1s |
| °C via Pt 100<br>100Ω RTD | −250°C to<br>+1000°C | 0.1°C | 1°C in range<br>−20 to +100°C | 1°C in range<br>−20 to +100°C | 1°C in range<br>−20 to +100°C | 1 mA drive current | dependent on probe | | PM 9249 range −60°C to +200°C |
| Diode Test | 1V dc | 100 µV | 0.3 + 0.1 | 0.3 + 0.1 | 0.3 + 0.1 | 1 mA drive | <1s | 750V p-p | |
| Continuity Test | 1 kΩ | 100 MΩ | 0.5 + 0.1 | 0.5 + 0.1 | 0.5 + 0.1 | 1 mA drive | <0.2s | 750V p-p | Beeper |
| dB V ac | −51 dB to<br>+43 dB | 0.1 dB (>10 mV)<br>1 dB (<10 mV) | as V ac | as V ac | as V ac | Referenced to 1 mW 600Ω | as V ac | as V ac | |
| dB V dc | −47 dB to<br>+53.8 dB | 0.1 dB (>10 mV)<br>1 dB (<10 mV) | ±0.1dB (>10 mV)<br>±1dB(<10 mV) | ±0.1dB (>10 mV)<br>±1dB(<10 mV) | ±0.1dB (>10 mV)<br>±1dB(<10mV) | Referenced to<br>1 mW 50Ω | as V dc | as V ac | 1 mW 50Ω |
| mAs | 20 mAs<br>100 mAs<br>2 As<br>20 As | 10 µAs<br>100 µAs<br>1 mAs<br>10 mAs | N.A. | 1% + 0.3% (in 3% to 100% of range) | N.A. | as I dc | as I dc | as I dc | Optional PM 2618 only |

# Handheld Multimeters

## Series 18 Handheld Multimeters

**Relative Reference Setting:** ON/RECALL; with pushbutton ZERO OFF; with push-button CLEAR
**Maximum Voltage:** HI and LO 250V rms; HI and GROUND 400V rms; LO and GROUND 400V rms

## General Specifications

### Environmental Conditions

**Reference Temperature:** 23°C ±2°C
**Rated Range of Use:** 0°C to +45°C
**Operating Range of Use:** −10°C to +55°C
**Storage & Transport:** −40°C to +70°C
**Limits of Humidity for Operation:** 20% to 80%

### Power Requirements

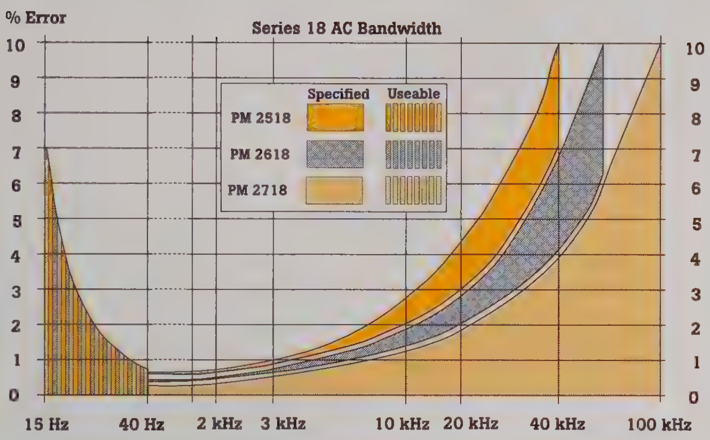
**Power Supply:** 4 × R14 batteries or PM 9218A Power Supply Adapter
**Power Consumption:** /02 versions 45 mW typical; /12 versions 189 mW typical (light on)

### Safety and Calibration

**Calibration Interval:** 1 year
**Max Dew Point:** +28°C
**Safety:** Class II according to IEC 348/VDE 0411/UL 1244

### Mechanical Data

**Size:** 170 mm L × 55 mm W × 188 mm H (6.7 in L × 2.2 in W × 7.4 in H)
**Weight:** 0.7 kg (1.5 lb)



## Ordering Information

### Models

**PM 2518/02** Standard version *$395*
**PM 2518/12** Standard version w/backlight display *$520*
**PM 2618/02** Extended version *$450*
**PM 2618/12** Extended version w/backlight display *$590*
**PM 2618/32** mAs version w/backlight display *$1100*
**PM 2718/02** High accuracy version *$560*
**PM 2718/12** High accuracy version w/backlight display *$655*

### Included with Instruments

One-year product warranty, PM 9266 safety leads and probes, spare fuses and Operator manual.

### Accessories

**PM 9053** Adapter, Banana (m) - BNC (f) *$22*
**PM 9071** Coax Cable, Banana (m) - Banana (m) *$65*
**PM 9072** Coax Cable, Banana (m) - BNC (m) *$65*
**PM 9210** 1 GHz Probe, 50 *$365*
**PM 9212** Accessory Kit for PM 9210 *$320*
**PM 9218A/01n*** Power Adapter (115V/50 Hz to 60 Hz) *$70*
**PM 9244/001** AC/DC 30A Shunt *$105*
**PM 9245** 100A AC Current Probe *$105*
**PM 9246/04** 30 kV Probe *$215*
**PM 9249/01** Platinum RTD Temperature Probe *$220*
**PM 9266 /03** Pair of Safety Test Leads *$60*
**PM 9267/01** Data Hold Probe *$215*
**PM 9278/02** Carrying Case *$115*

*The **n** indicates the required line cord. To select your line cord substitute the **n** by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

### Manuals

**PM 2518/02/12, 2618/17** Service P/N 858795 *$40*
**PM 2618/02/12** Operator P/N 885178 *$10*
**PM 2618/32** Operator P/N 862784 (Supplement w/885178) *$3*

### Factory Warranty

One-year product warranty.

## System 21 Modular GPIB Switching System Selection Guide

| **Master and Custom Units** | | | | | | | **Maximum Power** | **Connector Type** | **Description** |
|---|---|---|---|---|---|---|---|---|---|
| PM 2101 | GPIB Master Unit | | | | | | 16 VA | GPIB | Controls and powers up to 50 slave units. Uses only one GPIB address. |
| PM 2150 | Customer Adaptable Unit | | | | | | 200 mA at 5V±5% | Euroconnector for a Eurocard | Allows the development of custom slave units. Uses 5V CMOS or TTL chips. |

| **Switches** | | **Number of Switches** | | | | **Switching Speed** | **Maximum Switching Power** | **Connector Type** | **Description** |
|---|---|---|---|---|---|---|---|---|---|
| | | **Mode 1** | **Mode 2** | **Mode 3** | | | | | |
| PM 2120 | Universal Switch | 20 | 10 | 10 | | 10 to 20 ms<br>Note 1 | 30V<br>200 mA | 37 pin (D) female | 20 individual ON/OFF switches. 10 SPDT over switches. |
| PM 2121 | Low Level Switch (3µV Thermal Offset) | 20 | 10 | 4 | | <10 ms<br>Note 1 | 24V<br>500 mA | 37 pin (D) female | 1, 2 or 4 pole switching, with guard lines protected against current transitions. |
| PM 2122 | 50Ω Coaxial Switch | 4 | – | – | | <10 ms<br>Note 1 | 24V<br>250 mA | | A VHF coaxial switch with a 50Ω impedance for dc to 500 MHz. |
| PM 2124 | Current Switch | 6 | – | – | | (50 + 50 × n) ms<br>n=1 to 6 Note 1 | 2500 VA ac<br>300W dc | Amphenol 97 Series | Allows the switching of high currents and high voltages, 10A and 250V. |

| **Digital Input/Output** | | **Number of Channels** | | | | **Switching Speed** | **Maximum Switching Power** | **Connector Type** | **Description** |
|---|---|---|---|---|---|---|---|---|---|
| | | **Inputs** | **Outputs** | | | | | | |
| PM 2130 | Digital Input/Output | 2× 4 | 8 | | | <8 ms<br>Note 1 | 30V rms | 37 pin (D) female | 2x4 optically isolated inputs and 8 optically isolated outputs. |
| PM 2131 | Digital Input | 4× 4 | – | | | <8 ms<br>Note 1 | 30V rms | 37 pin (D) female | 4x4 optically isolated inputs, externally powered. |
| PM 2132 | Digital Output | – | 2× 8 | | | <8 ms<br>Note 1 | 30V rms | 37 pin (D) female | 2x8 optically isolated outputs, protected against short circuiting & inductive loads. |

| **Data Acquistion** | | **Input/Output Ranges** | | | | **Measurements Per Second** | **Maximum Power of the Switching Relay** | **Connector Type** | **Description** |
|---|---|---|---|---|---|---|---|---|---|
| | | **Voltage** | | | **Current** | | | | |
| | | **Range 1** | **Range 2** | **Range 3** | **Range 1** | | | | |
| PM 2140 | Analog Input<br>Resolution: | 200 mV<br>10µV | 2V | 20V | 250 mA<br>10µA | 1.6 to 10 | 10W | 37 pin (D) female | An Analog-to-Digital converter with programmable high and low limit relays. |
| PM 2141 | Analog Output<br>Resolution: | ±2V<br>1 mV | ±20V<br>10 mV | – | ±20 mA<br>10µA | – | – | 37 pin (D) female | A 12-bit Digital-to-Analog converter with two voltage and one current range. |
| PM 2160 | Pt-100 Temperature Unit | Pt-100 RTD | – | – | – | .8 to 2 | 10W | 37 pin (D) female | An input module for Pt-100 RTDs with programmable high and low limit relays. |

Note 1: These times work out to approximately 10 per second for an average combination of Slave Units programmed in BASIC on a PC, using block programming mode.

# System/Bench Multimeters

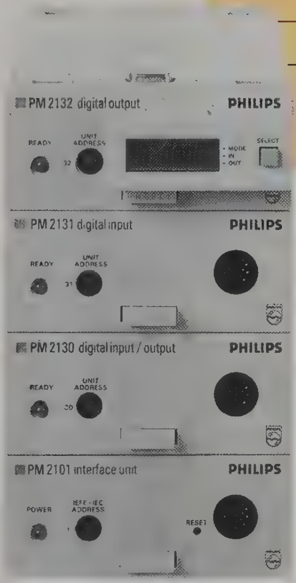
## System 21 Modular GPIB Switching System

Modular architecture

Wide range of different units for large number of applications

For the bench or the rack

Easy configuration



System 21 offers simple, low-cost solutions for flexible GPIB switching systems. Twelve functional units cover a wide range of functions, including switching, digital I/O and analog-digital/digital-analog conversion. Special-purpose modules like a Pt 100 temperature unit, a custom user-adaptable unit and a display module add further flexibility and functionality. You can create exactly the system you need, with minimal complexity. The System 21 Master Unit handles all communication with the GPIB bus. The switching system occupies only a single bus address, allowing maximum freedom in instrumentation system configuration. Up to 50 slaves can be connected to the Master Unit, using the System 21 Power Supply Unit if additional power is needed. Connection couldn't be simpler – the System 21 modules just click together, mechanically and electronically.

### Simpler Programming; Less Coding

All system operations are controlled by simple commands. Each module works independently, and can store commands for later triggering by the controller. That means simpler programming, and far less coding of repetitive tasks. In addition, most modules have multiple operating modes. So you can increase flexibility by configuring each module several ways. The Universal Switch, for example, can be configured three ways: as 20 individual on/off switches, as 10 break-before-make switches, or as 10 make-before-break switches. Similarly, the digital input/output units can be used in either direct or latching modes. All units have multiple execution modes, including a scan mode to activate individual switch inputs in sequence with minimum coding – yet another way to simplify your work. With System 21, GPIB testing has never been so easy. You control the entire system through one Master Unit, and easy-to-use software intelligence is distributed throughout the system for easy programming. And you can reconfigure your system any way you want, quickly and easily.

### Controlling System 21 Modules, via PM 2534 and PM2535

Many system applications demand measurements to be made at a number of different points typically requiring large and expensive scanners. But with the PM 2534 and PM 2535 system multimeters, System 21 can be added to any GPIB application to provide a modular and cost-effective solution to system switching. Both the PM 2534 and PM 2535 have a System 21 Master Unit built-in, enabling them to control any System 21 switch units.

System 21 Slave Units connect to the internal bus connector on the rear of the PM 2534 or PM 2535 with a PM 2192 Extension Cable Set. Control commands are accepted via the PM 2534 or PM 2535 GPIB interface and retransmitted to the System 21 internal bus, eliminating the need for costly interfaces, cables and power supplies.

The PM 2535 also has the capability to control System 21 Slave Units without the need of an instrument controller. Through the SEQUENCE function, the PM 2535 can create a 99 step program. Each step of the program is associated with one of ten functional DMM set-ups. Both the SEQUENCE program and the 10 functional DMM set-ups are stored in non-volatile memory.

## Specifications

**Display Module:** The optional PM 2190 Display Module can be plugged into the front panel socket of each unit, except the Master Unit, to provide status information.
**Terminal Connector:** One or more terminal connectors are provided on the rear panel of each unit

### Environmental Data

**Operating Temperature:** 0 + 55°C
**Storage Temperature:** –40 + 75°C
**Humidity:** 80% (0 + 55°C)
**Dew point:** 25°C

### Mechanical Data

**Mechanical Construction:** All units are housed in a separate chassis. Mechanical interconnection of units is by means of the feet of each unit.
**Size:** 105 mm W × 44.4 mm H × 226 mm L (4.3 in W × 1.7 in H × 8.9 in L) (excluding connectors and feet)
**Height of Feet:** 11 mm (0.43 in)

## Module Specifications

### PM 2101 Master Unit

The PM 2101 Master Unit supplies power to the complete system and handles communication between the GPIB interface bus and the System 21 internal bus.

### Bus Communication

Communication between the GPIB bus and the internal bus is fully transparent. Messages addressed to the Slave Units are not influenced by the Master Unit

### Power Supply

**Power:** 110, 120, 220 or 240V AC±10%, 50 Hz or 60 Hz
**Power Consumption:** 16 VA max
**Safety:** Class II acc. to IEC 348
**Secondary Power Supply to Slave Units:** 7.5V (at full load) to 15V (unloaded)
**Maximum Current Load:** 750 mA (If higher currents are needed, additional PM 2198 power supply units can be used in parallel)

### System Control Functions

Control functions of the Master Unit include identification, synchronization and service request handling

### Identification

On request, the Master Unit returns:
a. Type number and version of the Master Unit
b. List of connected Slave Units

### Trigger Facilities

Trigger commands from the GPIB bus can be distributed to:

- Individual units
- All units with identical type numbers
- All units

If required, these trigger commands can be delayed until the ready line is "true"

# System/Bench Multimeters

## System 21 Modular GPIB Switching System

### Reading the Ready Line

On request, the Master Unit returns the status of the System 21 ready line

### Resetting the System

The system can be reset to power-on conditions via the GPIB bus, or by means of a (protected) reset button on the Master Unit

### Service Request Handling

The Master Unit includes masking facilities to select from several reasons for service request messages. These include:

- Power failure or illegal command
- Addressed unit is not present or has synchronization error
- A unit has data available, has reached end of block or has a functional warning
- Changes in ready or trigger lines

The Master Unit returns detailed information on the source of the service request by means of a polling procedure.

### PM 2120 Universal Switch

The PM 2120 Universal Switch offers 20 switches grouped in 10 pairs, each with a common contact. Depending on the mode setting, the switches can be used as:

- 20 individual on/off switches with one common contact per pair
- 10 single pole double throw (SPDT) break-before-make or make-before-break switches.

The contacts are high quality reed relays able to handle 200 mA, 30V and frequencies up to 100 kHz.

### Technical Specifications

**Configuration:** 10 elements of 2 switches with a common output

**Operating Modes**

**Mode 0:** 20 individual switches (with common output per pair) for multiplexing or matrix switching

**Mode 1:** 10 SPDT make-before-break

**Mode 2:** 10 SPDT break-before-make

**Maximum Switching Voltage:** 30V rms

**Maximum Switching Current:** 200 mA

**Maximum Switching Power:** 10 VA (resistive load)

**Maximum Common Mode Voltage between Terminals or between Terminal and Ground:** 30V rms ac or 42V dc

**Frequency Range:** DC to 100 kHz

**Series Resistance:** <0.5Ω

**End-of-Life Resistance:** <2Ω

**Open Contact Resistance:** >$10^9$Ω

**Isolation Resistance:** >$10^9$Ω

**Crosstalk Isolation:** 60 dB at 100 kHz, $R_0$=50Ω

**Switching Time Individual Relay:** <10 ms, until last relay has settled in any mode: <25 ms, break-before-make or make-before-break; 10 to 20 ms

**Maximum Switch Rate:** 15/sec

**Terminal:** 37-pin female D-type connector

**Display Module:** The optional PM 2190 Display Module shows:

- Switching mode, synchronization mode and ready status
- Settings of individual switches

**Current Consumption for System Supply:** 25 mA (all switches open) to 125 mA (all switches closed)

### PM 2121 Low-Level Switch

The PM 2121 Low-Level Switch offers 5 switches (each 4 wires + guard) at the input, and mode-switching at the output. Depending on the switching mode, the switches can be used for scanning:

- 20 channels of 1 wire + guard (guard in common for 4 channels)
- 10 channels of 2 wires + guard (guard in common for 2 channels)
- 5 channels of 4 wires + guard

Switch contacts are designed for switching low signal levels. The contact potential is <3 μV

### Technical Specifications

**Configuration:** 5 elements of 4 contacts+ guard at the input and a mode switching unit at the output

**Operating Modes**

**Mode 1:** 1 wire (+ guard) scanning of 20 inputs

**Mode 2:** 2 wire (+ guard) scanning of 10 inputs

**Mode 4:** 4 wire (+ guard) scanning of 5 inputs.

A common guard for 4 contacts is used in all modes

**Maximum Switching Voltage:** 24V rms

**Maximum Switching Current:** 500 mA rms

**Maximum Switching Power:** 12 VA (up to 1 MHz)

**Maximum Common Mode Voltage Between Terminals or Between Terminal and Ground:** 24V rms ac or dc

**Frequency Range:** DC to 1 MHz

**Series Resistance:** <1Ω

**End-of-Life Resistance:** <2Ω

**Open Contact Resistance:** >$10^9$Ω

**Isolation Resistance:** >$10^9$Ω

**Crosstalk Isolation:** >90 dB (50/60 Hz); >40 dB (1MHz)

**Switching Time Individual Relay:** <10 ms, until last relay has settled in any mode: <25 ms

**Maximum Switch Rate:** 10/sec.

**Terminal:** 37-pin female D-type connector

**Display Module:** The optional PM 2190 Display Module shows:

- Switching mode, synchronization mode and ready status
- Selected channel

**Current Consumption for System Supply:** Typical 25 mA, max. 50 mA

### PM 2122 50Ω Coaxial Switch

The PM 2122 50Ω Coaxial Switch Unit switches one of four channels to a common channel.

The unit is suitable for switching VHF signals up to 500 MHz and 24V rms. Matching impedance is 50Ω

### Technical Specifications

**Switch Configuration:** 4 single pole double throw switches selecting 1 of 4 inputs

**Operating Mode:** Fixed

**Matching Impedance:** 50Ω (open inputs are not terminated)

**Maximum Switching Voltage:** 24V rms ac

**Maximum Switching Current:** 250 mA rms

**Maximum Switching Power:** 3 VA (50Ω load)

**Maximum Common Mode Voltage Between Terminals or Between Terminal Ground:** 24V rms ac or dc

**Frequency Range:** DC to 500 MHz

**VSWR:** <1.2 at 100 MHz;<1.5 at 500 MHz

**Series Resistance:** <1Ω

**End-of-Life Resistance:** <2Ω

**Open Contact Resistance:** >$10^8$Ω

**Isolation Resistance:** >$10^8$Ω

**Crosstalk Isolation:** >50 dB at 100 MHz,>25 dB at 500 MHz

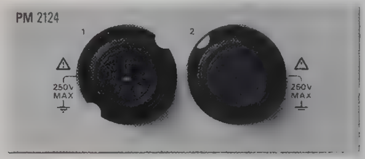
**Switching Time Individual Relay:** <10 ms, until last relay has settled: <25 ms

**Terminals:** 50Ω BNC connectors

**Display Module:** The optional PM 2190 Display Module shows:

- Synchronization mode and ready status
- Selected channel

**Current Consumption for System Supply:** Typical 35 mA, maximum 60 mA



### PM 2124 High Current Switch

The PM 2124 High Current Switch offers 6 independently controlled, bistable switches in groups of three. It can switch ac power up to 2500 VA and dc up to 300W. The high current switch may be used for testing motors and other electromechanical devices. The switches are provided with earth connections. They meet the IEC 348, Class 1 safety specifications.

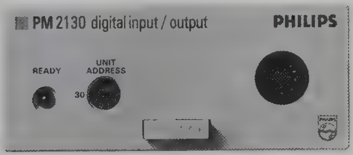
### Technical Specifications

**Configuration:** 6 independently controlled bistable switches in 2 groups of 3

**Operating Mode:** Fixed

## System 21 Modular GPIB Switching System

**Maximum Switching Voltage:** 250V rms ac, 400V dc
**Maximum Switching Current:** 10A ac at up to 250V, 10A dc at up to 30V, max. 25A per terminal
**Maximum Switching Power:** 2500 VA ac, 300W dc
**Series Resistance:** <50 mΩ
**Isolation Resistance:** 2 MΩ
**Cross Talk:** Negligible up to 1 kHz
**Inrush Current:** 50A
**Switching Time:** Bistable relays switched in sequence - total switching time 50 ms+ (n× 50 ms) for n contacts.
**Maximum Switch Rate:** 8/sec.
**Terminals:** 2× Amphenol series 97 terminals. Two corresponding plugs are supplied
**Display Module:** Optional PM 2190 shows position of relays.
**Current Consumption From System Supply:** Typically 25 mA



### PM 2130 Digital I/O Unit

The PM 2130 Digital Input/Output Unit provides 8-bit input and output with optical isolation for logic signals from 0V to 30V. Outputs can be loaded up to 100 mA. The inputs can be latched, and can set a warning flag when they match a reference pattern.

#### Technical Specifications

**Configuration:** 2 groups of 4-bit input and 1 group of 8-bit output with a common return line per group
**Operating Modes**
**Mode 0:** 8 input bits and 8 output bits
**Mode 1:** 8 latching input bits and 8 output bits
**Latching Mode:** In the latching mode a latch is set when the corresponding input is high for a period of>1 ms. The latches are reset by the RSL command.
**Reference Facility:** By setting a reference for the individual inputs to "don't care", low, high or changing state, a matching input or a change in input can be detected. The corresponding warning flag can be used to generate a service request message.
**For Input/Output Details:** See Table 1
**Timing**
**Response Time on Setting Commands:** <8 ms
**Response Time on Read Commands:** <8 ms
**Minimum Pulse Width to Set"Match Reference" Flag:** 5 ms
**Minimum Pulse Width to Set Latch:** 0.5 ms
**Maximum Input/Output Rate:** 15 bytes/sec.
**Terminal:** 37-pin female D-type connector
**Display Module:** The optional PM 2190 Display Module shows:

- Synchronization mode and ready status
- Data sent to the output
- Logic states of the inputs

**Current Consumption:** <100 mA

### PM 2131 Digital Input Unit

The PM 2131 Digital Input Unit provides 16-bit optically isolated input subdivided into 4 groups of 4 bits. Signal levels can be from 0V to 30V. The inputs can be latched. The inputs can be compared with preset reference to check on state or change of state.

#### Technical Specifications

**Configuration:** 4 groups of 4-bit input with optical isolation and a common return line per group
**Operating Modes**
**Mode 0:** 16 input bits
**Mode 1:** 16 latching input bits
**Latching Mode:** In the latching mode a latch is set when the corresponding input is high for a period of >1 ms. The latches are reset by the RSL command.
**Reference Facility:** By setting a reference for the individual inputs to "don't care", low, high or changing state, a matching input or a change in input can be detected. The corresponding warning flag can be used to generate a service request message.
**For Input Details:** See Table 1
**Timing**
**Response Time on Setting Commands:** <8 ms
**Response Time on Read Commands:** <8 ms
**Minimum Pulse Width to Set "Match Reference" Flag:** 5 ms
**Minimum Pulse Width to Set Latch:** 0.5 ms
**Maximum Input Rate:** 15 words/sec.
**Terminal:** 37-pin female D-type connector
**Display Module:** The optional PM 2190 Display Module shows:

- Operating mode, sychronization mode and ready status
- Logic states of the inputs

**Current Consumption:** <80 mA

### PM 2132 Digital Output Unit

The PM 2132 Digital Output Unit provides 16-bit optically isolated output subdivided into 2 groups of 8 bits. Signal levels can be from 0V to 30V. The outputs can be loaded up to 100 mA.

#### Technical Specifications

**Configuration:** 2 groups of 8-bit output with optical isolation, and a common line per group
**For Output Details:** See Table 1
**Timing**
**Response Time on Setting Commands:** <8 ms
**Maximum Output Rate:** 15 words/sec.
**Terminal:** 37-pin female D-type connector
**Display Module:** The optional PM 2190 Display Module shows:

- Synchronization mode and ready status
- Data sent to the output

**Current Consumption from System Supply:** <200 mA

### PM 2140 Analog Input

The PM 2140 Analog Input offers a 3 range input channel for dc voltages up to 25V, and a separate single range current input up to 250 mA. The two inputs have a common floating low and are provided with a guard.

Maximum resolution is 10 μV in the 200 mV range and 10 μA in the current range. Measuring speed is 1.6 or 10 measurements per second. An input filter can be switched on for increased SMRR.

The PM 2140 also includes two relays that can be activated by the input signal when passing a programmable high or low limit. The contacts of these relays are connected to rear mounted terminals.

#### Technical Specifications

**Configuration:** 3 range dc voltage and single range dc current input with floating low and a guard. High and low limit detection with relays for external signaling.
**Operating Modes**
**Mode 0:** Measurements with 4.5 digit resolution
**Mode 1:** Measurements with 3.5 digit resolution
**For Ranges and Accuracy:** See Table 2
**Limit Detection**
**Limit Setting Range:** −25,000 to +25,000 counts for mode 0; −25,000 to + 25,000 counts for mode 1
**For Both High and Low Limit**
**Maximum Limit Relay Load:** 10W
**Maximum Voltage:** 30V rms or 42V dc
**Maximum Current:** 500 mA
**Start of Measurements:** Free-running or triggered via the GPIB bus, measuring results are available 80 ms (mode 1) or 600 ms (mode 0) after start of measurement
**Terminal:** 37-pin female D-type connector
**Display Module:** The optional module PM 2190 shows:

- Operating mode, trigger mode and ready status
- Measured value
- High limit setting

### Table 1. Input and Output Specifications for PM 2130, 2131, 2132

| | Input | Output |
|---|---|---|
| **Max Common Mode Voltage Between Groups and Ground** | 30V rms ac or 42V dc | 30V rms ac or 42V dc |
| **External Supply Voltage** | 5 to 30V(max) | 5 to 30V(max) |
| **External Supply Current** | <10 mA (per group of 4-bit) | <1A (per group of 8-bits and including max load current) |
| **Logic** | Positive | Positive (current source) |
| **Levels** | Low for<30% of supply voltage<br>High for>70% of supply voltage | |
| **Hysteresis** | 0.4V to 1.7V | |
| **Input Voltage Range**<br>**Input Resistance**<br>**Input RC Time** | −30 to+30V<br>100 kΩ<br>0.1 ms | |
| **Max Load Current** | | 100 mA (outputs may be used in parallel) |
| **Output Voltage** | | Supply voltage−1V at 100 mA load |
| **Current at Output Low** | | <1 mA |
| **Output Protection** | | Short-circuit protected and flyback diodes |

- Filter on/off

**Current Consumption from System Supply:** Max<100 mA

## PM 2141 Analog Output Unit

The PM 2141 is a 12-bit Digital-to-Analog Converter, which offers a choice of both voltage and current output modes. The voltage output mode has two ranges, ±2V and ±20V and the current output mode has one range, ±20 mA. The voltage and current output modes have a resolution of 2000 counts. Both of the outputs are floating with respect to the system and safety grounds. For safe operation, the output voltage must never exceed 42V (dc or dc + ac peak). The voltage output has separate sensing wires to eliminate voltage drop across the output wires. This also allows a power supply to be added to increase output power.

### Technical Specifications

**Programmed Output Voltage (Mode 1)**
**Output Voltage Range:** −2V to+2V
**Current Range:** −10 mA to+10 mA
**Resolution:** 1 mV (1:4000)
**Accuracy:** ±(0.1% of value+ 0.1% of range)
**Output Impedance:** 0.1Ω (or 1 mV/10 mA)
**Programmed Output Voltage (Mode 2)**
**Output Voltage Range:** −9V to+9V
**Current Range:** −20 mA to 20 mA
**Resolution:** 10 mV (1:4000)
**Accuracy:** ±(0.1% of value+ 0.05% of range)
**Output Impedance:** 0.1Ω (or 1 mV/10 mA)
**Output Voltage (max):** +20.5V
**Programmed Output Current (Mode 3)**
**Output Current Range:** ±20 mA
**Current Range:** ±9V
**Resolution:** 10µA (1:4000)
**Accuracy:** ±(0.1% of value+ 0.05% of range)
**Output Impedance:** 0.1µA/V
**Output Admittance:** 0.1µA/V/K

### General Specifications

**Response Time:** Approximately 50 ms after master unit
**Setting Time:** Approx 40 ms
**Display Module:** Optional display adapter PM 2190 shows:

- Mode
- Output voltage
- Output current

**Current Consumption from System Supply:** Max 325 mA, typical 250 mA

## PM 2160 Temperature Unit for Pt 100

The PM 2160 offers temperature measurement with Pt 100 sensors from −200°C to +850°C with resolution of 0.1°C. The result is linearized and output in ASCII for direct input to a system controller.

Results can be compared to preset high and low limits. If they are exceeded, a warning is sent to the controller and a relay in the unit is activated.

### Technical Specifications

**Configuration:** Single 4-wire connection to Pt 100 sensor, current source/voltage input float w.r.t. main system
**Operating Mode:** Fixed
**Measurement Range:** −200°C to+850°C, resolution 0.1°C
**Overload Indication:** 999.9°C
**Accuracy (not incl. sensor):** ±(0.1% of reading+0.5°C) (−100°C to 850°C) ±(0.1% of reading+1°C) (±200°C to 100°C)
**Temperature Coeff:** ±(0.01% of reading +0.1°C)/°C
**Common Mode Voltage:** Floating sensor connection max 30V rms or 42V peak or dc w.r.t. system 9/send
**Measurement Time:** 0.5s (−50°C to +250°C) 0.63s max at −200°C, 1.25s max at +850°C
**Measurement Trigger:** Free running or triggered by systems bus
**Limit Relay Output**
**Maximum Switching Voltage:** 30V ac or 42V dc
**Maximum Switching Current:** 0.5A
**Maximum Switching Power:** 10W
**Maximum Contact Resistance:** 100 mΩ
**Limit Parameters:** The output can be compared with a high and low limit (+850°C or −200°C). Out of limit generates an SRQ signal for the controller, and activates high or low relays, accessible on the rear panel.
**Terminals:** 37-pin female D-type connector
**Display Module:** Optional PM 2190 shows trigger mode and ready status, measured value (or overload), and high and low limit value
**Current Consumption from System Supply:** Max 100 mA

## PM 2150 User Adaptable Unit

The User Adaptable Unit allows the implementation of a user-built function on the IEEE-488 bus. For this reason, a power supply and a connector for a standard Eurocard are provided in the unit. Sixteen I/O lines are available for interfacing to the user-built circuitry.

### Technical Specifications

**Configuration:** Two groups of 8 I/O lines, read or written in groups, and with a common return
**Signal Levels:** CMOS 5V compatible with 10 kΩ pull-up
**Power Supply:** A maximum of 200 mA at 5V±5% is available for user-built circuitry
**Use of I/O Lines:** The 16 I/O lines can be used in any I/O line configuration
**Reference Facility:** A matching state of I/O lines can be detected by reference setting. The corresponding warning flag can be used to generate a service request message. The reference pattern can consist of: "don't care", low, high or "changing state" bits.
**Timing**
**Response Time on Read or Write Command:** <10 ms
**Minimum Pulse Width to Set "Match Reference" Flag:** 10 ms
**Control Commands:** All I/O lines can be set or read individually or in combination in binary, decimal, hexadecimal or ASCII code. The reference can be set in binary, decimal or hexadecimal codes ("don't cares" and "change state" in binary code only).

# System 21 Modular GPIB Switching System

**Display Module:** The optional Display Module shows:

- Synchronization mode and ready status
- Data sent to the I/O lines
- Status of the I/O lines

**Current Consumption from System Source:** <250 mA

## Accessories

### PM 2190 Display Module

The PM 2190 Display Module has an 8-digit LCD to show programmed modes and settings of the Slave Units during debugging. The module can be plugged onto the front panel connector of any Slave Unit. (The parameters shown on the Display Module are specified for each Slave Unit.)

### PM 2191 Terminal Adapter

The PM 2191 Terminal Adapter adds a screw-connection terminal to Slave Units which have a 37-pin D-type terminal.

### PM 2192 Extension Cable Set

A set of flat cables and connectors enabling the System 21 internal bus to be extended so that units can be used at different places in a rack. The set contains:

- 1M flat cable with an internal bus connector at one end
- 3 additional connectors

### PM 2193 19″ Rack Mount Kit

This rack mount kit allows up to 8 System 21 units or 4 System 21 units plus one PM 2525/34/35 DMM to be mounted in a standard 3E high rack unit. Wiring for interconnection of the units is provided as standard.

### PM 2194 Blank Panels (Rack Mount Kit)

The PM 2194 provides blank panels for the PM 2193 Rack Mount Kit. The rack mount kit holds up to eight System 21 modules. If fewer than eight modules are used, the blank panels will cover the empty locations in the rack mount kit.

The PM 2194 provides enough pieces to cover seven locations of the rack mount kit, when a single System 21 module is mounted.

### PM 2198 Additional Power Supply Unit

In extensive systems requiring more current than the 750 mA capacity of the PM 2101 Master Unit, additional PM 2198 Power Supply Units can be connected in parallel. Each additional PM 2198 provides an additional 750 mA.

## Technical Specifications

**Power:** 110V, 120V, 220V or 240V ac± 10%, 50 Hz or 60 Hz
**Power Consumption:** 16 VA max
**Safety:** Class II acc to IEC 348
**Secondary Power Supply for Slave Units:** 7.5V (at full load) to 16V (unloaded)
**Maximum Current Load:** 750 mA

## Ordering Information

### Model

**PM 2101/02n** Master Unit *$945*

### Switches

**PM 2120/02** Universal Switch *$680*
**PM 2121/02** Low-Level Switch *$855*
**PM 2122/02** 50Ω Coaxial Switch *$970*
**PM 2124/02** High Current Switch *$960*

### Digital I/O

**PM 2130/02** Digital I/O Unit *$820*
**PM 2131/02** Digital Input Unit *$820*
**PM 2132/02** Digital Output Unit *$820*

### Data Acquisition & Custom Units

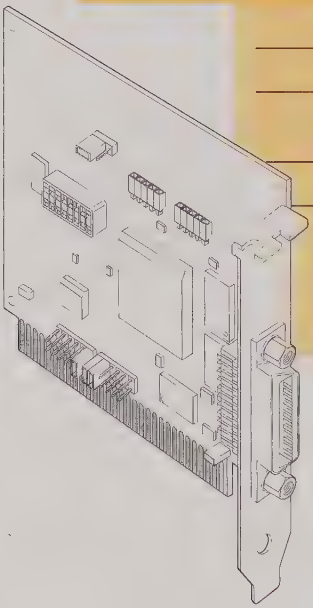
**PM 2140/02** Analog Input Unit *$855*
**PM 2141/02** Analog Output Unit *$975*
**PM 2150/02** User Adaptable Units *$565*
**PM 2160/02** Pt-100 Temperature Unit *$850*

### Accessories

**PM 2190/02** Display Module *$270*
**PM 2191/01** Terminal Adapter (qty: 3) *$275*
**PM 2191/10** Teminal Adapter (qty: 1) *$100*
**PM 2192/01** Extension Cable Set *$90*
**PM 2193/03** Rack Mount Kit *$325*
**PM 2194/02** Blank Panel for Rack Mount Kit *$105*
**PM 2198/02n** Additional Power Supply Unit *$500*

The **n** indicates the required line cord. To select your line cord substitute the **n** by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

## PM 2201 GPIB/IEEE-488.2 Interface for PC



Turns Personal Computer into versatile GPIB system controller

Supports MS-DOS and Windows 3 operating environment

Supports Visual Basic, QuickBasic, Turbo Pascal and Microsoft C programming languages

Fully compatible with SCPI, IEEE-488.2 and other GPIB instruments

Supports AnyWave, TimeView, LabWindows™, LabView®, MET/CAL™ and a whole range of other software packages

### Hardware

The PM 2201 interface card is a quick, convenient and economical way to control GPIB instruments with a PC.

The PM 2201 contains the widely used PC II/IIA GPIB interface from National Instruments for the IBM PC/XT/AT and 100% compatibles.

The widespread acceptance of these cards ensures total compatibility with the many software packages designed for use with them.

### Software

With the PM 2201/03, a library of GPIB routines is supplied that can be called from one of the supported programming languages. These routines comply with the controller functionality of the IEEE-488.2 specification. Also non-IEEE-488.2 instruments can be controlled with these routines.

For Windows 3.x, a GPIB Dynamic Link Library is supplied. This can be used by any Windows application or programming language to control the GPIB interface. For Visual Basic and MicroSoft C an include file is available to facilitate the programming effort. Example programs are included that demonstrate programming with Visual Basic. One example demonstrates the acquisition and display of waveforms from a CombiScope™. Another example demonstrates the control of a Programmable Power Supply.

The PM 2201/98 interface cards are a lower cost alternative that can only be used in conjunction with another software package. With these versions only the GPIB device driver is supplied.

### System Requirements

- PM 2201: IBM PC/XT/AT or compatible
- Memory: 640K
- MS-DOS/PC-DOS 3.0 or higher or Windows 3.0 or higher
- Floppy disk and one hard disk drive
- Visual Basic 1.0. QuickBasic 4.5, MicroSoft C 5.0. Borland Turbo Pascal 5.5 or higher versions

## Specifications

| CHARACTERISTICS | SPECIFICATIONS | ADDITIONAL INFORMATION |
|---|---|---|
| Type of interface | RS-232 / EIA-232-D | Optically Isolated |
| States: SPACE = 0<br>MARK = 1 | Light<br>No light | Wavelength 800 nm |
| Signal levels: RXD<br>other signals | SPACE = +10V to +4V<br>MARK = -4V to -10V<br>SPACE = +12V to +7V<br>MARK = -7V to -12V | Maximum input voltage + 15V<br>Maximum input voltage -15V<br>Maximum input voltage + 15V<br>Maximum input voltage -15V |
| Handshake Method | XON/XOFF | Software handshake only |
| Environmental<br>• Meets requirement of<br>• Temperature<br>Operating<br>Storage 0°C to +50°C | MIL-T-288800D Type III, Class 3<br>CE<br>0°C to +50°C<br>-20°C to +70°C | As of January 1996 |
| Mechanical<br>Cable length<br>Weight | 1.5 m<br>0.14 kg | |

## Ordering Information

### Models

**PM 2201/03** GPIB Interface for PC with GPIB.COM device driver and GPIB Driver Software ***$820***

**PM 2201/98** GPIB Interface for PC with GPIB.COM device driver, without GPIB Driver Software ***$700***

### Accessories

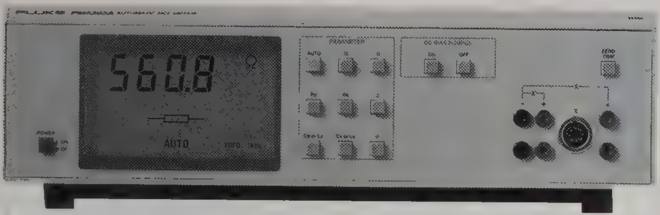
**Y8021** Cable IEEE-488, 1m (3.28 ft) ***$195***
**Y8022** Cable IEEE-488, 2m (6.56 ft) ***$210***
**Y8023** Cable IEEE-488, 4m (13 ft) ***$220***

MicroSoft, MS-DOS, QuickBasic, Visual Basic are trademarks of MicroSoft Corp. IBM, PS/2 MicroChannel are trademarks of International Business Machines Corp. LabWindows, LabView are trademarks of National Instruments. Turbo Pascal is a trademark of Borland Inc.

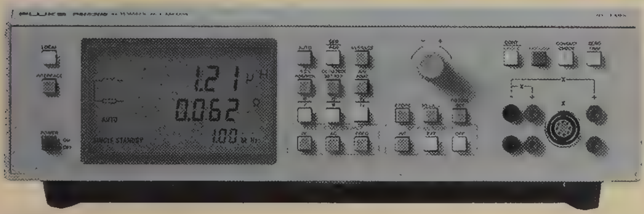
*GPIB = General Purpose Interface Bus; equivalent to IEC-625.1 and IEEE-488 standards
SCPI = Standard Commands for Programmable Instruments

# RCL Meters

Testing resistors, capacitors, and inductors has just gotten much easier with the introduction of the PM 6303A and PM 6404 RCL Meters. These models feature a large LCD display and automatic operation. The PM 6303A is an easy-to-use instrument that is ideal for getting quick component checks. Consider the PM 6304 for enhanced measurement capability and optional RS-232 or GPIB/IEEE-488 remote programmability. PM 6306 adds measuring power flexibility and accuracy by offering selectable text frequencies of up to 1 MHz.

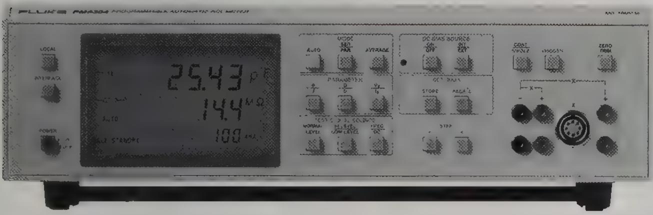


PM 6303A



PM 6306

**New** Product



PM 6304

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**RCL Accessories Software**
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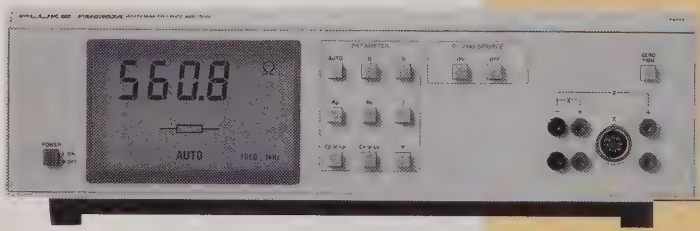
# Automatic RCL Meters

## PM 6303A Automatic RCL Meter



PM 6303A

- Big backlit, easy to read, LCD display
- Fully automatic and direct access to all parameters
- Fast display of component value, dimension and equivalent circuit
- Automatic zero trimming of test fixture
- Optional 4-wire test adapter for standard leaded components
- Optional fixture for fast, easy SMD testing
- Optional 4-wire Kelvin clip cable

### Fast Operation, Clear Display

The new PM 6303A offers fast and simple determination of the value and electrical characteristics of any passive component or circuit. Results are displayed on a large backlit LCD display.

The PM 6303A's easy operation and instant results make it an ideal tool for incoming inspection and service. It allows quick determination of whether components are within their specified values, or value of unknown components.

Other likely application areas for this versatile instrument include education and training, quality control, batch sampling and troubleshooting.

### Complete Information Display in Less than a Second

All that is necessary to perform a test is to connect the unknown component or passive circuit, using either a 2- or 4-wire technique, select the test parameter, and complete information about component characteristics is displayed in less than a second.

Dominant component values are measured to an accurary of greater than 0.25%, while at the same time the display shows the relevant electrical dimension and one of seven equivalent circuit diagrams.

Testing of unknown components is further simplified by the AUTO mode button, which gives an immediate display of the dominant value of the component without the need for further setup.

Any of 8 specific parameter tests, with or without DC-bias, can be directly selected at the touch of a button.

These include serial and parallel resistance, impedance, capacitance, inductance, dissipation and quality factors and phase angle.

A 2 Vdc bias test is provided specifically for measuring electrolytic capacitors.

### Large LCD Display

A simple user interface allows direct access to all parameters for fast, efficient setting-up of tests. The large backlit display allows results to be readout at-a-glance.

To compensate for parameters like stray capacitance and residual inductance of different test adapters another enhancement in the PM 6303A is zero trimming. This is performed automatically when the 'trim' key is pressed.

### Simple SMD Testing, Too!

The PM 6303A is perfect for fast, easy 4-wire testing of miniature SMDs (Surface Mounted Devices), using the optional test fixture PM 9542SMD and the PM 9542A universal test adapter.

The universal test adapter (PM 9542A) also allows easy 4-wire testing of conventional components.

### Test Cable with Kelvin Clips (PM 9541A)

When making measurements of in-circuit components, connection between the PM 6303A and the component to be tested is easy with the 4-wire test cable PM 9541A.

### SMD Tweezers Accessory (PM 9540/TWE)

This handy accessory is designed to work with the PM 6303A, PM 6304 and PM 6306 Automatic RCL Meters and makes SMD component testing fast and easy. With the PM 9540/TWE, all that is required is to simply grasp the component between the tips and read the measurement on the RCL meter. No need to load or unload the component from a test fixture saves valuable time. Plus the tweezers can be used to directly pick up the component under test from a tray or static pad, thus reducing the chance of contamination of the component's contacts.

Although designed to meet the needs of SMD component accessories, the tweezers may be used on most other form factor components as well.

## Specifications

### Technical Specifications

**Display:** Large backlit, 4-digit LCD
**Dimension Indications:** Ω, kΩ, MΩ, pF, nF, μF, mF, μH, mH, H, kH, DEG
**Out of Range Indication:** 4 middle digit segments flashing
**Equivalent Circuits:** 7 equivalent circuits

### Measuring Functions & Ranges

| | |
|---|---|
| Resistance (Rp, Rs, Z) | 0.000Ω to 200 MΩ |
| Capacitance (Cp, Cs) | 0.0 pF to 100 mF |
| Inductance (Lp, Ls) | 0.0 μH to 32 kH |
| Q and D Factor (Q, D) | 0.002 to 500 |
| Phase Angle | −90 to +90 degree |

### Maximum Resolution

| | |
|---|---|
| Resistance/Impedance | 1 mΩ |
| Capacitance | 0.1 pF |
| Inductance | 0.1 μH |
| Q and D Factor | 0.001 |
| Phase angle | 0.1 degrees |

### Measurement Parameters

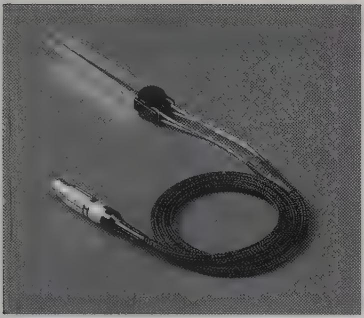
**Measuring Accuracy:** ±0.25% ±1 digit
**Measuring Frequency:** 1 kHz ±0.025%
**DUT Stress:** ≤5 mA, ≤2V (linked to a 2 Vrms source with an internal resistance of 400Ω)
**Measurement Update Rate:** approx. 2 measurements/s

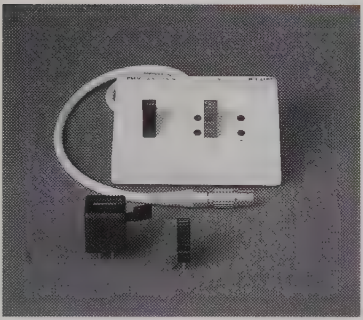
### Connectors

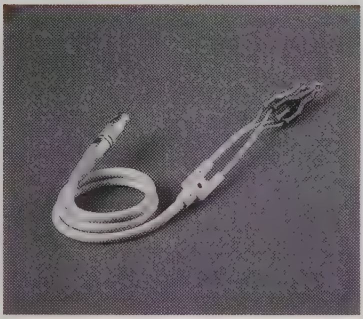
2 mm sockets - 2x2 red sockets for measuring voltage (Hi) drive and sense connection; 2 black sockets for measuring current (Lo) drive and sense connection. 8-pin connector for PM 9541A or PM 9542A

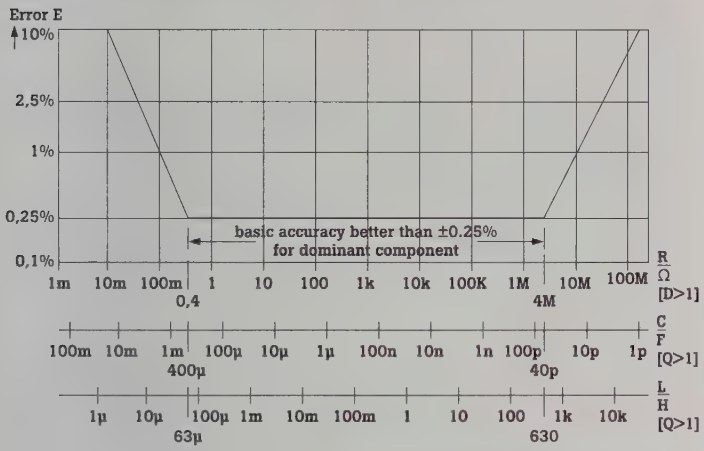
# Automatic RCL Meters

## PM 6303A Automatic RCL Meter



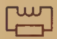
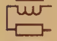
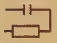
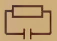


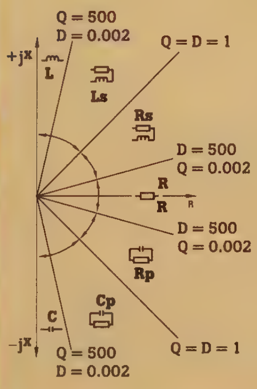



Error E
10%
2,5%
1%
0,25%
0,1%
basic accuracy better than ±0.25%
for dominant component
1m 10m 100m 1 10 100 1k 10k 100K 1M 10M 100M
0,4
4M
R
Ω
[D>1]
100m 10m 1m 100µ 10µ 1µ 100n 10n 1n 100p 10p 1p
400µ
40p
C
F
[Q>1]
1µ 10µ 100µ 1m 10m 100m 1 10 100 1k 10k
63µ
630
L
H
[Q>1]

**Equivalent circuits**
-7 Equivalent circuits

D > 500
D < 0.002, Q > 500
Q > 500, no display of the secondary parameter

| | D or C<br>Q=D=1 | parameter selection |
|---|---|---|
|  | 500 | RCLAUTO, Cp, Rp, D, Z |
|  | 500 | Cs, Rs |
|  | 500 | RCLAUTO, Ls, Rs, Q, D, Z |
|  | 500 | Lp, Rp |



### Power Requirements

**Voltage:** 110, 120, 220, 240V ±10%
**Frequency:** 50 to 100 Hz ±5%
**Power Consumption:** 12W

### Environmental Data

**Ambient Temperatures**
**Reference Value:** +23°C ±1°C
**Operation:** 0°C to +40°C
**Storage and Transport:** −40°C to +70°C
**Size:** L (12.4 in W × 4.13 in H × 15.9 in L)
315 mm W × 105 mm H × 405 mm
**Weight:** 3.8 kg (8.4 lb)

## Ordering Information

### Model

**PM 6303A** Automatic RCL Meter ***$1600***

### Included with Instrument

2 single test posts (red and black), operating manual, operating card, and line cord.

### Accessories

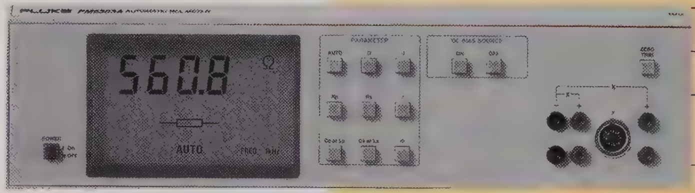
**PM 9541A** Four-wire Test Cable ***$125***
**PM 9542A** RCL Test Adapter ***$340***
**PM 9542SMD** SMD Adapter for PM 9542A ***$140***
**PM 9564** Rack Mount Kit (for PM 6303A manufactured after Nov 1992) ***$240***
**PM 9540/TWE** SMD Tweezers ***$360***

### Manuals

**PM 6303A** Operator P/N 948344 ***$40***
**PM 6303A** Service P/N 948448 ***$40***

# Automatic RCL Meters

## PM 6304 and PM 6306 Programmable Automatic RCL Meters



PM 6306

**New Product**

- Programmable test frequencies from DC to 1 MHz
- 0.1% basic measurement accuracy
- DC resistance measurements (optional)
- RS-232 and IEEE-488 interfaces
- AC and DC test levels from 50 mV rms to 2Vrms
- Up to 10V internal DC bias and external bias to 40V DC
- 9 front panel set-ups in memory; recall last set-up on power up
- Actual component test voltage/current readback
- Deviation mode to display measurements as tolerance percentage
- Contact check

### Selection Guide

| Function | PM 6304 | PM 6306 * |
|---|---|---|
| Basic Measurement Accuracy | 0.1 % | 0.1 % |
| Measurement Functions | R, Z, C, L, Q, D, V (monitor), I (monitor) | R, Z, C, L, Q, D, V (monitor), I (monitor) % Dev |
| AC Test Frequency | 50, 60, 100, 120 Hz, 200 Hz to 20 kHz (100 Hz resolution), 100 kHz | 0, 60, 100, 120 Hz, 200 Hz to 100 kHz (100 Hz resolution), 100 kHz to 1 MHz (1 kHz resolution) |
| AC Test Levels | 300 mV @ 100Ω, 1V @ 100Ω, 2V @ 400Ω | 50 mV to 2.00V @ 100Ω (10 mV resolution) |
| DC Bias | 2 V internal, ≤ 40 V external | 0 to 10V internal (100 mV resolution), ≤ 40 V external |
| DC Test Mode (Optional) | 300 mV @ 100Ω, 1V @ 100Ω, 2V @ 400Ω | 50 mV to 2.00V @ 100Ω (10 mV resolution) |
| Test Modes | Normal (2 meas/sec), Fast (10 meas/sec) | Normal (2 meas/sec), Fast (10 meas/sec) |
| Software | Optional PM 2272, windows based available in '96 | Optional windows based available in '96 |

### A Versatile Component Measurement System

The PM 6304 and PM 6306 combine excellent component measurement power and versatility with remote programmability. Operation is as simple as ever—just connect the component to the test posts or fixture, and you can instantly read the dominant and secondary values plus see an equivalent circuit diagram on the large LCD display. The available options, including GPIB/IEEE-488* or RS-232 interfaces, DC resistance, component handler interface, and, add up to a very powerful component test system—from the development lab right through to the production line.

### More Measurement Capability

The PM 6304 and the PM 6306 provide accurate testing of components under voltage and frequency conditions that closely match actual operational environments. For testing primary power components, such as filter capacitors, the both models offer 50 and 60 Hz, along with the 100 Hz and 120 Hz ripple frequencies. In the 100 Hz to 20 kHz range, the PM 6304 and PM 6306 provide 100 Hz resolution for precision frequency characterization. And for the most accurate measurement of small value capacitance, the PM 6306 adds test frequencies up to 1 MHz.

AC component test voltage level of the PM 6304 is selectable between 1V or 2V for standard component testing to 50 mV to keep sensitive semiconductor junctions below their voltage thresholds. DC bias can be added either from the built-in 2V source or from an external source up to 40V. Measuring the DC resistance of a component can be done with the optional DC resistance capability.

The PM 6306 gives you more ability to precisely match real operational conditions of components by allowing AC and DC levels to be programmed throughout their range with a 0.01V AC resolution and a 0.1V DC resolution, plus provide 1 kHz resolution for test frequencies up to 1 MHz. These flexible settings allow you to accurately analyze component performance over wide frequency ranges and various loads. Plus the PM 6306 offers a fast Contact Check function to confirm the quality of your test connection and ensure the validity of your measurement.

### Select the Test You Need

Besides the fully automatic operation that displays the dominant parameters and component models, the user can manually select the parameters of interest. Press a key to lock in component phase angle, impedance, Q (quality) and D (dissipation) factors. Select the current/voltage monitoring function to see the actual test current and voltage values measured at the component under test. This ensures maximum protection for current-sensitive components and allows the test current to be specified together with the measured component parameters. Plus the PM 6306 Deviation Mode lets you specify a nominal value and read percent deviation from that value. This makes evaluation of component tolerance specifications much more straightforward and convenient.

### Computer-Aided Component Test

The optional RS-232 or IEEE-488 interfaces and test software make the PM 6304 and PM 6306 cost-effective solutions for automated test set-ups such as an incoming inspection or quality assurance in manufacturing. With the IEEE-488 interface, they can serve as a fully automated component test environment with speeds up to 10 measurements per second. The RS-232 interface allows simple and economical automated operation from a PC for incoming inspection of components and devices.

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*The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

* Available November 1995

# Automatic RCL Meters

## PM 6304 and PM 6306 Programmable Automatic RCL Meters

### Component Binning

If your application involves component sorting for example for incoming inspection you'll find the binning function a big time saver. Tolerance limits to sort components into as many as ten bins may all be programmed. The binning limits can also be programmed, archived, and recalled from a PC using software.

### Fast Set-up and Calibration

Close-case calibration can be performed very easily. All you need are 100Ω and 10 kΩ reference resistors for quick and complete calibration of the instrument. Connection of test components is quick and simple; either directly to the detachable test posts which are conveniently located on the front panel, or using the PM 9542A universal test adapter or PM 9541A test cable with Kelvin clips.

### Easier SMD Testing Tools

Testing surface mount devices has always been a challenge, with small physical size, no wire leads, and with tiny markings. The PM 9542SMD SMD test fixture is a unique design that allows accurate characterization of most passive SMD components. Plus the PM 9540/TWE Tweezers accessory permits quick and easy identification and testing of SMD as well as other form factor components.

### ComponentView Software

The PM 6304 and PM 6306 are uniquely suited for data analysis and quality control applications with its optional windows software. Running on a PC, ComponentView lets you name, store and recall instrument setups for quick, consistent testing of components. The software also adds the capability for test data storage, recall, analysis and export to a spreadsheet or Statistical Quality Control analysis program.

The ability to perform measurement scans (sequence of single measurements) makes the ComponentView software really powerful.

## Specifications

### Technical Specifications

### AC Test Mode

**Test Frequencies:**

| PM 6304 | PM 6306 |
|---|---|
| 50, 60, 100, 120 Hz<br>200 Hz to 20 kHz in 100 Hz steps<br>100 kHz<br>DC (optional) | 50 Hz, 60 Hz, 100 Hz, 120 Hz<br>200 Hz to 100 kHz in 100 Hz steps<br>100 kHz to 1 MHz in 1 kHz steps<br>DC (optional) |

**Test Frequency Accuracy:** 0.01%

### Test Signal Levels:

**PM 6304:** 2V via 400Ω source, 1V via 100Ω source, 50 mV via 100Ω source
**PM 6306:** 50 mV to 2.00V @ 100Ω (10 mV resolution)

### DC Bias

**Internal:**
**PM 6304:** 2V ±5%
**PM 6306:** 0 to 10.0V ±2% in 0.1V steps
**External:** 0 to 40V

### DC Test Mode (optional)

**Test Signal Levels:**
**PM 6304:** 300 mV @ 100Ω, 1V @ 100Ω, 2V @ 400Ω
**PM 6306:** 50 mV to 2.00V @ 100Ω (10 mV resolution)

### Basic Measurement Accuracy

(2 readings/second):

| PM 6304 | PM 6304C | PM 6306 |
|---|---|---|
| f ≤20 kHz: 0.1% (1V or 2V test level),<br>0.5% (50 mV test level)<br>f = 100 kHz: 0.4% (1V or 2V test level),<br>2.0% (50 mV test level) | f ≤ 2kHz: 0.05% (1V test level) | f ≤50 kHz: 0.1% (0.25 to 2V test level)<br>f >50 kHz: 0.1% *(f/50 kHz) (0.25 to 2V test level) |

### Measurement Functions

| Function | Parameter | Measurement Range | Resolution |
|---|---|---|---|
| R or Z | AC Resistance or Impedance | 0.0000 Ω to 200 MΩ | 0.1 mΩ |
| R (DC) | DC Resistance | 0.0000 Ω to 50 MΩ | 0.1 mΩ |
| C | Capacitance | 0.00 pF to 31.8 F | 0.01 pF |
| L | Inductance | 0.00 μH to 637 kH (μH for PM 6306) | 0.01 μH |
| Q | Quality Factor | 0.000 to 1000 | 0.001 |
| D | Dissipation Factor | 0.000 to 1000 | 0.001 |
| Φ | Phase Angle | −179.0° to +180.0° | 0.1° |
| V monitor | Voltage across CUT | 0.1 μV to 2.00V | 0.1 μV |
| I monitor | Current through CUT | 0.005 μA to 10.0 mA | 0.001 μA |
| % Dev (PM 6306 only) | Deviation from nominal (tolerance) | −100% to +100% | 0.1% |

### Display Modes

7 different equivalent circuit diagrams

### Auto

**Readout:** Dominant and secondary values
**Equivalent Circuit Diagram:** Parallel for R+C, Series for R+L

### Manual

**Readout:** Dominant and secondary values
**Equivalent Circuit Diagram:** Series or parallel mode selectable
**Average Function:** Exponential averaging in continuous mode

### Measurement Modes

**Normal Mode**
**Single Triggered:** via "TRIG" key; via handler interface (PM 6304 only); via IEEE-488 or RS-232
**Fast Mode** (display blanked)
**Continuous:** 10 meas/sec
**Single Triggered:** via handler interface (PM 6304 only); via IEEE-488 or RS-232

### Contact Check Mode (PM 6306 only)

Automatic check of contact resistance at UUT to validate good connection with UUT.

### Binning Mode

**Standard Bins:** 9
**Special Bins:** Bin "0" and bin "fail"
**Bin Programming Via:** PM 9559 hand held controller (PM 6304 only), GPIB interface, or RS-232 interface
**Bin Limit Programming:** Absolute or relative
**Stored Settings** (non-volatile memory)
**Front Panel Settings:** 9 (trim data included)
**Bin Settings:** 9
**Print Measurement Results:** Via RS-232 direct to printer (talk only mode)
**Trim Functions:** Open circuit compensation, >100 kΩ; short circuit compensation, <10Ω

### Calibration

**Calibration Interval:** 1 year
**Required for Calibration:** One of the following: PM 9559 hand held controller (PM 6304 only); GPIB interface or RS-232 interface

### Options

**PM 9548 IEEE Interface Kit**
**Control Capability:** All functions
**Address Range:** 1 to 30
**PM 9549 RS-232 Interface Kit**
**Signals:** All optically isolated

## PM 6304 and PM 6306 Programmable Automatic RCL Meters

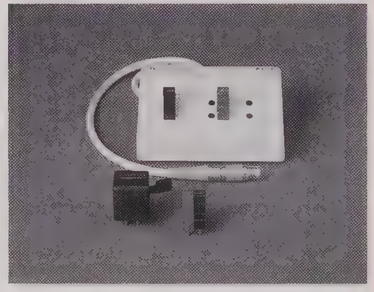
**Control Capability:** All functions
**Baud Rates:** 110, 150, 300, 600, 1200, 2400, 4800, 9600, 19200
**Connector:** 9-pins D-connector, male

**PM 9565 DC Measurement Option Kit**
Technical Specification: See "DC test mode"

**PM 9566 Handler Interface**
**Signals:** All optically isolated
**Inputs:** Trigger input
**Outputs:** Bin 0-9, FAIL indication

### Environmental Data

**Operating Temperature:** 0°C to 50°C
**Storage Temperature:** −40°C to +70°C
**Power Requirements:** 100V/120V/220V/240V ±10%
**Line Frequency:** 50 Hz/60 Hz
**Power Consumption:** 31 VA
**Safety:** IEC 348, CSA C22.2 No. 231
**Warm-Up Time:** 5 minutes
**Size:** 105 mm H × 315 mm W × 405 mm L (4.13 in H × 12.4 in W × 15.9 in L)
**Weight:** 4.7 kg (10.4 lb.)



## Ordering Information

### Models

**PM 6304** Programmable Automatic RCL Meter *$2350*

### Included with Instrument

One-year product warranty, front panel 4-wire test points.

### Factory Installed Options – PM 6304 only

When ordering use PM 6304 as your prefix, then select your desired 3-digit suffix from below:

**/00n** RCL Meter *$2350*
**/02n** RCL Meter w/GPIB Interface *$2925*
**/03n** RCL Meter w/RS-232 Interface *$2770*
**/04n** RCL Meter w/DC Measurement Unit *$2880*
**/06n** RCL Meter w/DC Measurement Unit and GPIB Interface *$3455*
**/07n** RCL Meter w/DC Measurement Unit and RS-232 Interface *$3300*
**/50n** RCL Meter w/Handler Interface *$2720*
**/52n** RCL Meter w/Handler Interface and GPIB Interface *$3295*
**/53n** RCL Meter w/Handler Interface and RS-232 Interface *$3140*
**/54n** RCL Meter w/Handler Interface and DC Measurement Unit *$3250*
**/56n** RCL Meter w/Handler Interface, DC Measurement Unit and GPIB Interface *$3825*
**/57n** RCL Meter w/Handler Interface, DC Measurement Unit and RS-232 Interface *$3670*

### Models

**PM 6304C/02n** Programmable Automatic RCL Meter with improved accuracy (incl. GPIB interface). *$3925*

**PM 6306** Programmable Automatic RCL Meter *Contact Factory*

### Factory Installed Configurations

**PM 6306/02n** 1 MHz RCL Meter with GPIB Interface *$4235*
**PM 6306/03n** 1 MHz RCL Meter with RS-232 Interface *$4070*
**PM 6306/06n** 1 MHz RCL Meter with DC Measurement Unit & GPIB Interface *$4800*
**PM 6306/07n** 1 MHz RCL Meter with DC Measurement Unit & RS-232 Interface *$4635*
**PM 6306/52n** 1 MHz RCL Meter with Handler Interface and GPIB Interface *$4630*
**PM 6306/53n** 1 MHz RCL Meter with Handler Interface and RS-232 Interface *$4465*
**PM 6306/56n** 1 MHz RCL Meter with Handler Interface, DC Measurement Unit and GPIB Interface *$5195*
**PM 6306/57n** 1 MHz RCL Meter with Handler Interface, DC Measurement Unit and RS-232 Interface *$5030*

**Options** (service center installable only):
**PM 9548** GPIB Interface* *$645*
**PM 9549** RS-232 Interface* *$480*
**PM 9565** DC Resistance Measurement** *$595*
**PM 9566** Handler Interface *$415*

*Only 1 interface may be installed in the instrument at one time
**Recalibration required after installation

### Accessories

**SW 63** ComponentView Software *Contact Factory*
**PM 2295/10** IEEE-488 Cable - 1 meter *$190*
**PM 2295/20** IEEE-488 Cable - 2 meter *$235*
**PM 9536/041** RS-232 Cable - 3 meter, 9 pin female/9 pin female *$55*
**PM 9540/TWE** SMD Tweezers - Tweezers w/ 2 wire contacts (4 wire to tip) cable length 1000 mm *$360*
**PM 9541A** 4-Wire Test Cable - 2 Kelvin Clips, cable length 600 mm *$125*
**PM 9542A** 4-Wire RCL Adapter - Kelvin Contacts in Test Posts, cable length 600 mm *$340*
**PM 9542SMD** 4-Wire SMD Adapter for PM 9542A - Kelvin Contacts within SMD Adapter, length 2 to 10 mm, width min 1 mm, height min 0.5 mm *$140*
**PM 9559** Bin Programmer (PM 6304 only) *$235*
**PM 9564** Rack Mount Kit - 2E (88.5 mm) height *$240*

### Manuals

**PM 6304** Operator*
**PM 6304** Programming*
**PM 6304** Reference
**PM 6304** Service
**PM 6306** Operator*
**PM 6306** Programming*
**PM 6306** Service

*No charge with purchase of unit or appropriate option

### Factory Warranty

**One-year product warranty**

The last digit of the type number is the indication for the local line voltage and local line cord. Following line voltage settings plus line cord are available:

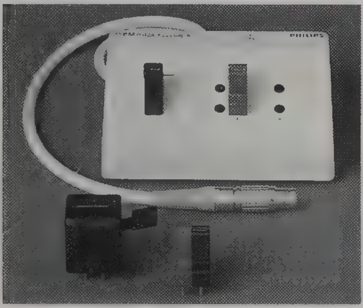
n = 1 Universal European 220V
n = 3 Standard North America 120V
n = 4 United Kingdom 240V
n = 5 Switzerland 220V
n = 8 Australia 240V

Example: PM 6304/573
Programmable RCL meter PM 6304 with Handler interface, DC measurement unit and RS-232 Interface factory installed. Includes Standard North American line cord.

# Automatic RCL Meter

## RCL Meter Accessories

Fluke's RCL Meter Accessories make interfacing to your CUT's fast and easy. From Kelvin Test Leads to SMD adapters, components of all types can be tested with speed, accuracy and convenience.

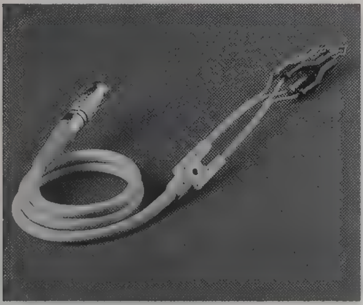


### PM 9542A Universal Test Adapter

The PM 9542A adapter allows easy 4-wire testing of conventional (leaded) components, inserted directly into the Kelvin contacts of the test posts. The adapter's angled position makes insertion and removal convenient for bench use.

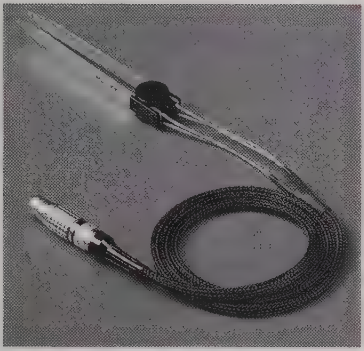
### PM 9542SMD Test Fixture for SMDs

Testing of miniature SMDs is made easy by the PM 9542SMD, used in combination with the PM 9542A. The 4-wire measuring technique ensures high accuracy, even for small SMD components.



### PM 9541A 4-Wire Test Cable Set with Kelvin Clips

This test cable set combines convenient connection to larger components and assemblies with the accuracy of 4-wire testing.

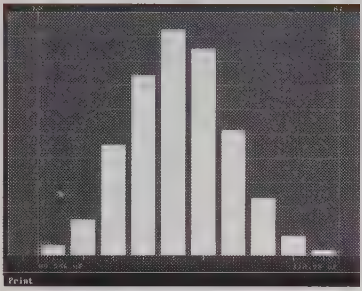


### PM 9540/TWE SMD Tweezers

The PM 9540/TWE SMD Tweezers make picking up, testing, and general handling of small components fast, convenient and accurate. With the PM 9540/TWE, all that is required is to simply grasp the component with the tweezers and read the measurement on the RCL meter. Although designed for the needs of SMD components, the tweezers are well suited for standard components as well. Nothing could be faster or more convenient.

### PM 9559 Bin Programmer (PM 6304 only)

The bin programmer is a compact hand held unit that programs the PM 6304's component sorting function. The display shows the preset component value for each of up to 9 bins. The bin programmer can also be used to initiate the PM 6304's closed case calibration function without the need for an RS-232 or GPIB interface.



### PM 2272 Inspector Software (PM 6304 only)

The Inspector PC software package adds extra versatility to automated testing. It provides powerful functions for the analysis of test results received via the RS-232 or IEEE-488 interface. Inspector software also allows all functions of the PM 6304 to be remotely controlled from a PC. Test results can be stored on disk, printed in report form, or exported to spreadsheet or statistical quality analysis programs.

### Windows® Based Software

In 1996, a new advanced RCL – meter software package will be released. Please request information about this easy-to-use and very powerful software package.

### PM 9564 Rack Mount Kit

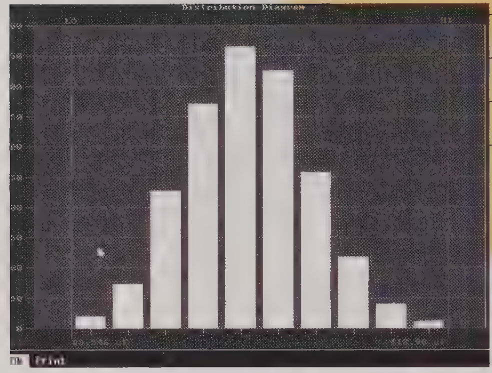
For system applications, the rack mount adapter for all RCL meters allows for installing your instrument in a 19" rack assembly. Height is a standard 2E unit height.

## Ordering Information

**PM 9542A** Universal test adapter *$340*
**PM 9542SMD** Test fixture for SMDs *$140*
**PM 9541A** 4-wire test cable set with Kelvin Clips *$125*
**PM 9540/TWE** SMD Tweezers *$360*
**PM 9559** Bin programmer (PM 6304 only) *$235*
**PM 2272/001** Inspector software (PM 6304 only) *$265*
**PM 9564** Rack Mount Kit *$240*

## PM 2272 Inspector Software for DOS

- Easy test setup
- Store measured data for later use
- Convenient visual analysis
- Statistical functions for quick examination
- Pass/fail testing
- Binning support for allocating components to defined sorting fields



### Easy Instrument Setup

Connect the PM 6304 RCL meter to your computer to automate your quality assurance and incoming inspection procedures. With the easy to use Inspector PC software, testing a batch of components or devices is no problem. Set up the instrument manually or automatically by recalling one of the previously stored setup files. Start testing components while Inspector collects the data, up to 9999 values can be handled.

### Storage and Export of Data

Single or multiple measurement data from the RCL meter can be saved on floppy or hard disk for later use. The storage and retrieval of captured data is very useful for scheduling time consuming analyses. The data can also be exported for use in your favorite graphics or statistics software package, e.g. Microsoft® Excel.

### View Function

The captured data (dominant and secondary values) can be plotted on screen in graphic or tabular form. A more convenient visual analysis is also offered by the sort function. The sort, in ascending or descending order, can be applied to the dominant or secondary parameters.

### Quick Examination

The dominant and/or secondary results can be used for statistical calculations. These statistical functions can be executed at the end of a measurement sequence or during capturing of data. The minimum, maximum, mean and standard deviation values will then be updated continuously. These statistical functions are very useful for quick examination of a complete batch.

### Pass/Fail Testing

Incoming inspection is made even easier by the pass/fail function. The dominant and/or secondary parameters can be used for testing. The nominal values and higher and lower limits can be entered separately for both parameters. The pass/fail function automatically shows the number of results in the high, pass and low groups. Special graphic symbols for pass, low and high indicate the result of each individual measurement.

### PM 6304 Binning

The software package supports the binning facility of the PM 6304 RCL meter. Binning limits can be programmed, stored and recalled. The facility indicates the binning group for each individual result or shows the results in a histogram. The software simplifies operation and observation of component binning.

### Extensive Analysis

The analyze mode can be used to classify test results on a linear scale for graphic display. This distribution diagram can then be used to check the spread of component values in batches by performing a limited number of measurements.

### Printer Support

The test results can be paper recorded either as a graph or in tabular form.

### Supported Instruments

PM 6304 RCL meter with an optional RS-232 or IEEE-488 interface

### System Requirements

IBM PC/AT or compatible
EGA or VGA graphics adapter
MSDOS® 3.0 or later, Min. 512 KB free memory
Microsoft® Mouse or compatible (recommended)
One free RS-232 port or GPIB interface

## Ordering Information

### Models

**PM 2272/001** Inspector for DOS ***$265***

### Accessories for Serial Communication

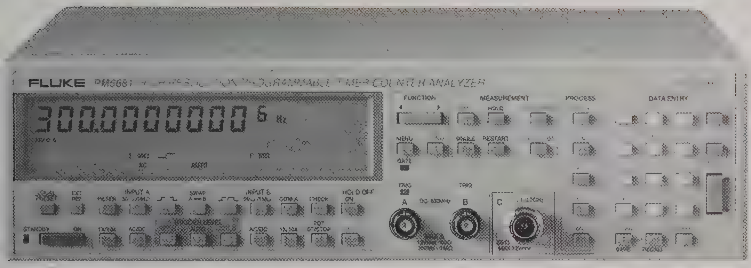
**PM9536/041** Serial Interface Cable, DB-9(f) to DB-9(f) ***$55***

### Accessories for GPIB Communication

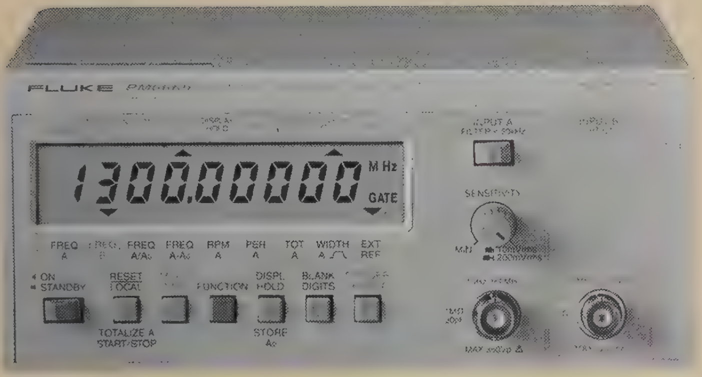
**PM 2201/03** GPIB/IEEE-488.2 Interface & Drivers for PC ***$820***
**PM 2295/05**[1] Cable GPIB-IEEE, 0.5m (1.64 ft) ***$180***
**PM 2295/10**[1] Cable GPIB-IEEE, 1m (3.28 ft) ***$190***
**PM 2295/20**[1] Cable GPIB-IEEE, 2m (6.56 ft) ***$235***
**Y8021** Cable GPIB-IEEE, 1m (3.28 ft) ***$195***
**Y8022** Cable GPIB-IEEE, 2m (6.56 ft) ***$210***
**Y8023** Cable GPIB-IEEE, 4m (13 ft) ***$220***

[1] Available in Europe Only

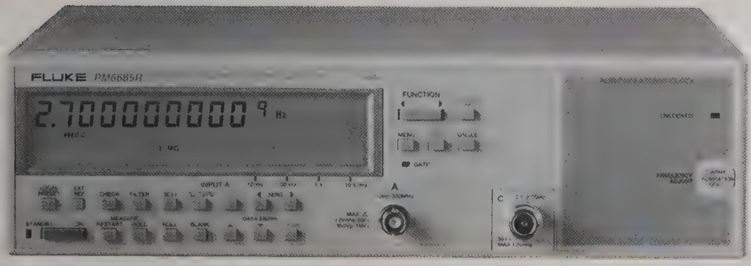
# Counters & Timer/Counters


FLUKE
300.0000000 6 Hz

PM 6681


FLUKE
1300.00000 MHz GATE
FREQ A
FREQ A/A₀
FREQ A-A₀
RPM A
PER A
TOT A
WIDTH A
EXT REF
ON STANDBY
RESET LOCAL
FUNCTION
DISPL HOLD
BLANK DIGITS
TOTALIZE A START/STOP
STORE A₀
INPUT A
SENSITIVITY

PM 6669


FLUKE PM6685R
2.700000000 9 Hz

PM 6685R

**New** *Product*

Whether you use frequency counters or timer counters: on the bench, in the field, in automated systems, on site calibration or Cal-Lab, Fluke can address your time and frequency measurement needs from economical solutions to state-of-the-art performance.

Fluke provides the broadest selection on non microwave counters in the industry. Models range from the PM 6662, with a price to suit any budget, to the high performance PM 6681 which offers single shot time interval resolution of 50 ps and the optional Rubidium reference for calibration applications.

The PM 6680B Timer/Counter/Analyzer offers thoroughbred performance at the price of a standard workhorse model. The PM 6681 offers the ultimate in performance for R&D, Cal-Lab or System use. Basic performance includes the 50 ps single shot time resolution, a 300 MHz frequency range (up to 4.5 GHz optional) and a measuring speed of up to 8000 readings/second to internal memory of 6.1K readings. Combined with TimeView software, the PM 6681 becomes a modulation domain analyzer, to characterize frequency behavior or time jitter over time in amazing detail.

The PM 6685 universal frequency counter brings Cal-Lab performance in the field. Options include a rechargeable battery pack and a selection of high stability oven oscillators.

The PM 6685R and PM 6681R are equipped with a rubidium reference oscillator with a short warm-up time 1x10$^{-9}$ in 6 min. for on-site calibration of e.g. GSM base station clocks or Cal-Lab calibrations of frequency, time-interval or phase.

## Contents

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**Multifunction Counters**
Page 95
**Software**
Page 103

# Counters & Timer/Counters

## Counter Selection Guide

| | | Economy Models | | | | High Performance | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | | Freq. Only | Univ. Freq. | Timer Counter | | Universal Frequency | | Timer/ Counter | | | |
| | **Functionality** | **6662** | **6669** | **6665** | **6666** | **6685** | **6685 R** | **6680B** | **6681** | **6681 R** | |
| **Counter** | Frequency LF MHz | 160 | 160 | 160 | 160 | 300 | 300 | 225 | 300 | 300 | **R&D** |
| | Opt. 1.3 2.7 4.2 4.5 GHz | 1.3 | 1.3 | 1.3 | 1.3 | ● | ● | ● | ● | ● | |
| | Period | | ●+RPM | ●+RPM | ● | ● | ● | ● | ● | ● | |
| | Ratio | | | ● | ● | ● | ● | ● | ● | ● | |
| | Burst / PRF / FM | | | | | ● | ● | ● | ● | ● | |
| | Totalize modes | | 1 | 3 | 3 | 1 | 1 | 6 | 6 | 6 | |
| **Timer** | Time Interval on 2 ch. | | | ● | ● | | | ● | ● | ● | |
| | Pulse Width | | ● | | | ● | ● | ● | ● | ● | |
| | Rise- & Fall time | | | | | | | ● | ● | ● | |
| | Duty Factor | | | | | ● | ● | ● | ● | ● | |
| | Phase | | | | | | | ● | ● | ● | |
| **Analyzer** | Measuring speed Rdgs/s | | | | | 1600 | 1600 | 2000 | 8-20-40k | 8-20-40k | |
| | Memory Capacity Rdgs | | | | | 2600 | 2600 | 2600 | 6100 | 6100 | |
| | Modulation Domain SW | | | | | opt. | opt. | opt. | incl. | incl. | |
| **Volt** | Vmax/Vmin (AC or DC) | | | | ● | | | ● | ● | ● | |
| **Trigger** | Level **A**uto **M**an **G**PIB Serial | A | AM | M | AMG | AMG | AMG | AMG | AMG | AMG | |
| | Sensitivity **A**uto **M**an **G**PIB Serial | M | M | M | M | AMG | AMG | AMG | AMG | AMG | |
| **Resolution** | Frequency resolution dig/s | 7 | 7 | 7 | 7 | 10 | 10 | 10 | 11 | 11 | **Cal Lab** |
| | Time resolution single | | | 100ns | 100ns | 250ps | 250ps | 250ps | 50ps | 50ps | |
| | Time resolution average | | | 1ns | 1ns | 100ps | 100ps | 100ps | 1ps | 1ps | |
| | Trigger level resolution mV | | | 20 | 20 | | | 20 | 1.25 | 1.25 | |
| | Input Sensitivity mV | 15 | 10 | 20 | 20 | 10 | 10 | 20 | 20 | 20 | |
| **Accuracy** | 1 year *1 | $5\text{x}10^{-7}$ | $5\text{x}10^{-7}$ | $5\text{x}10^{-7}$ | $5\text{x}10^{-7}$ | $7.5\text{x}10^{-8}$ | $9\text{x}10^{-10}$ | $7.5\text{x}10^{-8}$ | $7.5\text{x}10^{8}$ | $9\text{x}10^{-10}$ | |
| | Timebase options *2 | 2 | 2 | 2 | 2 | 4 | Rubidium | 4 | 4 | Rubidium | |
| **Features** | Analog output | | | | | ● | ● | ● | ● | ● | |
| | Arming | | | | | ● | ● | ● | ● | ● | |
| | Hold-off / Digital Filter | | | | | | | ● | ● | ● | |
| | Low pass filter analog | | ● | ● | | ● | ● | ● | ● | ● | |
| | Statistics / Full math | | | | | | | ● | ● | ● | |
| | Analog Bargraph | | | | | ● | ● | | | | |
| | Nulling | | ● | | | ● | ● | ● | ● | ● | |
| | Digit Blanking | | ● | ● | | ● | ● | ● | ● | ● | |
| | Interface RS-232/GPIB option | | GPIB | GPIB | GPIB | GPIB | GPIB | GPIB | GPIB | GPIB | **System use** |
| | GPIB Set-Measure-Read | | 5 | 5 | 5 | 125 Rdgs/s | | 125 | 250 | 250 | |
| | Size 19" 2HE | ½ | ½ | ½ | ½ | ½ | ¾ | ¾ | ¾ | ¾ | |
| | Warm up time [Min.] | 30 | 30 | 30 | 30 | 30 | 6 | 30 | 30 | 6 | |
| | Battery supply | Option | Option | Option | Option | Option | | | | | |
| | | **Field use** | | | | | | | | | |

*1 Best achievable accuracy with best TimeBase option up to one year after calibration

*2 Timebase options:

| | | |
|---|---|---|
| | PM 6660 series: | Standard / MTCXO |
| | PM 6680 series: | Standard / TCXO / Oven / Oven |
| | PM 6685R & PM 6681R | Rubidium |

# Counters & Timer/Counters

## Introduction

Applications for frequency and time-related measurements vary considerably. Requirements can include high-accuracy frequency calibration of RF signals, frequency measurements on noisy signals, accurate propagation delay measurements, phase shift in filters, high resolution counting on low frequency tone control signals, etc.

The instruments which perform these time-related measurements are generally known as counters. There are quite a number of names for various classes of these products. Today, there are two categories of these instruments: frequency counters and timer/counters.

### Frequency Counters

A frequency counter has a single input channel, and sometimes an additional prescaled input for measuring high frequencies. The most basic units offer frequency-only measurements. Most counters offer the following functions:

- Frequency
- Period

More versatile instruments also offer:

- Totalizing (Pulse Counting)
- Frequency ratio (relative mode)
- Frequency deviation (relative mode)
- Pulse Width
- RPM (freq × 60)
- Duty Factor
- Burst PRF

Typical applications for these products range from high accuracy calibrations of telecommunications equipment (normally in the RF range) down to low-cost frequency indicators for small repair workshops and hobbyists.

### Timer/Counters

In addition to the frequency measurements noted above, a timer/counter can also perform time interval measurement between two events (start and stop event). A timer/counter is therefore characterized by its dual and identical input channels, the start and stop channels (usually labeled A and B). A third input channel can be added for prescaled HF frequency measurements. Almost all timer/counters offer the following functions:

- Frequency
- Period
- Time Interval (Channel A to Channel B)
- Frequency Ratio (Channel A/Channel B)
- Totalizing

More advanced models offer a wealth of different functions, with the most common listed below:

- Pulse Width
- Rise/Fall Time
- Voltage Measurements
- Phase Delay (A to B)
- Duty Factor

Timer/counters are found in the lab or on the service bench and also in systems. These systems vary from small temporary set-ups to large ATE systems.

### Optional Accessories

The conditions of use are important. Use in the field, on a laboratory bench or in an automatic test system require different options such as: battery supply, analog output (for recording on a strip-chart recorder), IEEE-488 bus interface, rack mount facilities, ultra-high stability oven oscillators, etc.

In selecting a counter, the availability of a wide range of such options is of great importance especially when the type of application may change after some time in use.

### Front-end Circuitry Requirements

The requirements for input signal-conditioning when making frequency and time measurements are somewhat contradictory as the following observations will illustrate.

### Frequency Counting

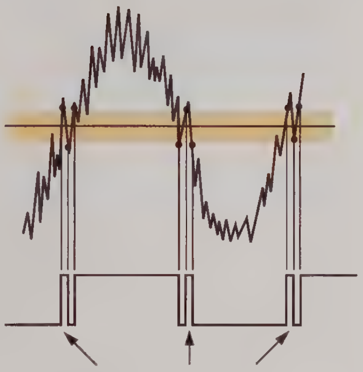
Figure 1a shows a sinewave signal crossing the hysteresis band of the input circuit. Each period of the sinewave that crosses the hysteresis band should cause a clean pulse that can be counted by the digital circuitry.

Noise on the sinewave, however, causes the signal to pass through the hysteresis band more than once per sinewave period giving false counts. Figure 1b shows how an expanded hysteresis band can prevent this type of error.

### Time Interval Measurement

Figure 2a shows a pulse, the duration of which is to be measured. Triggering at 50% of amplitude should start the time measurement at A and stop it at B.

The hysteresis of the input circuit, however, causes triggering to occur at A1 and B1. The different slopes of leading and trailing edges cause different delays, resulting in a faulty measurement. A very narrow hysteresis band as shown in Figure 2b will reduce these errors.

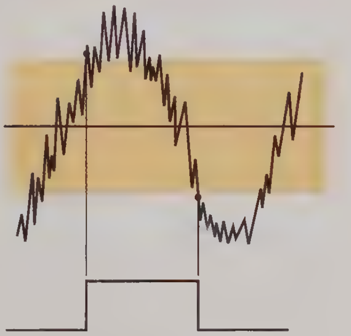


**False Counts due to noise**

Figure 1a.

### Error-Free Triggering

Figure 1b shows that "error-free" frequency counting is obtained by a wider hysteresis band or, in other words, by an attenuated input signal.



**Error free counting thanks to optimum expanded hysteresis band (increased attenuation)**

Figure 1b.

For frequency measurement a continuously variable input attenuator permits optimum matching of the input signal to the counter's trigger sensitivity.

Figure 2b shows that a lower hysteresis voltage will minimize the time measurement error.

A low hysteresis voltage (narrow trigger window) together with a continuously variable trigger level setting permits accurate time interval measurements.

## AC-Coupling

Frequency counting on sinewaves or on generally symmetrical signals is best achieved with ac-coupled inputs. AC-coupling has no temperature drift problems, while added dc signal components are eliminated. This assures simple, stable, and thus, reliable triggering.

Frequency counters also need to measure on narrow pulses or other waveforms.

Triggering on any waveform, having any duty factor can be performed by means of a trigger level off-set in the input channel amplifier, see Figure 3.

## DC-Coupling

Time interval measurements with accurately set trigger levels, or those that are waveform-independent, require dc-coupling. This might include rise time measurement on a pulse, requiring 10% to 90% level setting, or a pulse duration measurement with accurate setting of trigger levels at 50% of the pulse amplitude.

## Crystal Oscillators

A counter's maximum accuracy is ultimately limited by its time base reference accuracy.

Depending on the application requirement, most counter models can be ordered with a choice of different crystal oscillator time base options.

The crystal oscillator with the highest available stability (PM 9691), features a stability of $5 \times 10^{-10}$/24h, and can be included in the high accuracy counters of the PM 668X Series. Rubidium oscillators with one year accuracy of $2 \times 10^{-10}$ are available in the PM 6685R and the PM 6681R/076 for on site calibration or cal-lab calibration.

## Selection of Time Base Option

Depending on the application accuracy requirement, operating temperature range and tolerated recalibration interval, a suitable time base selection can be made. As general indication, one can state that the accuracy limitation, caused by the time base is as follows:

## Time Base Inaccuracy (Relative Error):

Time base error is determined by the summary of the following terms:

$$\frac{\partial f}{F} = \pm \frac{\partial fa}{F} \pm \frac{\partial ft}{F} \pm \frac{\partial fs}{F}; \text{ where}$$

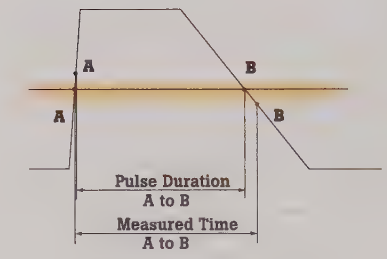
$\partial f$ : the deviation from the nominal 10 MHz crystal frequency

F : nominal 10 MHz crystal frequency

$\frac{\partial fa}{F}$ : relative deviation due to aging

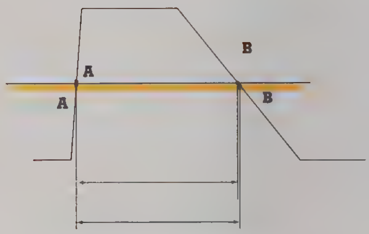
$\frac{\partial ft}{F}$ : relative deviation due to temperature changes from calibration temperature

$\frac{\partial fs}{F}$ : relative deviation due to supply voltage and/or supply mode variation



**Measured time is too long. The hysteresis causes different delay due to different slopes**

Figure 2a.

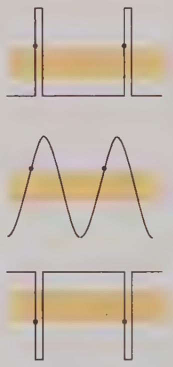


**Greatly reduced trigger error due to very narrow hysteresis band**

Figure 2b.

## Selection Guide Crystal Oscillator Options

| No. of Relevant Digits | Type of Crystal Oscillator | Option Numbers |
|---|---|---|
| 5-6 | Standard or Uncompensated | Standard or/.1. |
| 6-7 | TCXO w/analog Compensation | TCXO, /.2. or PM 9678 |
| 7-8 | TCXO w/Mathematic Compensation (MTCXO) or Oven Control | MTCXO or /.3., /.4. or PM 9607, PM 9679, PM 9690 |
| 8-9 | Ultra High Stability Oven Control | /.5. or PM 9691 |
| 10-11 | Rubidium | PM 6685R or PM 6681R/076 |



**Push ⎍ button for triggering on signal with duty factors of 0 to 0.25**

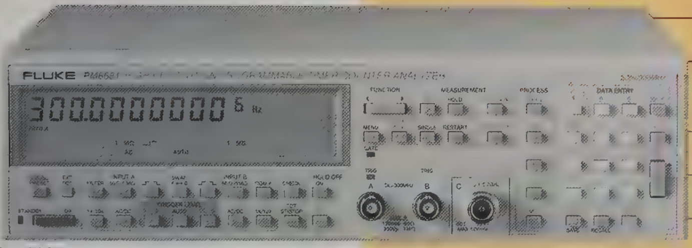
**Push ⊓⊔ button for duty factors between 0.25 to 0.75**

**Push ⎍⎍ button for duty factors of 0.75 to 1**

Figure 3.

# High Performance Timer/Counters

## PM 6681 and PM 6680B Timer/Counter/Analyzers

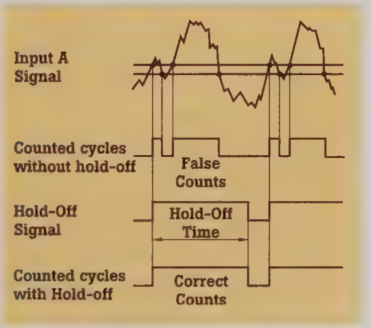


PM 6681

- Outstanding accuracy and resolution, plus powerful TimeView™ analysis
- 300 MHz range, optional to 4.5 GHz
- 50 ps single-shot time interval resolution
- Down to 1 ps averaged time interval resolution
- 11 digits per second measuring speed
- Repetitive sampling rate up to 10M/s
- Built in statistics and mathematics
- 8k readings/s to internal memory with 50 ps resolution
- Continuous single period measurements at up to 40k readings/s
- High trigger level resolution 1.25 mV
- Very low systematic time error 500 ps
- High phase accuracy to 0.02°
- TimeView™ PC software including frequency-vs-time, FFT
- 250 individually triggered readings/s via GPIB
- Choice of five timebase options incl. Rubidium oscillator

### Quick Selection Table

| Range | PM 6681 | PM 6680B |
|---|---|---|
| Single-shot time interval resolution | 50 ps | 250 ps |
| Averaged time interval resolution | 1 ps | 100 ps |
| Frequency resolution (1s measuring time) | 11 digits | 10 digits |
| Basic frequency A range | 300 MHz | 225 MHz |
| Measuring speed to internal memory | 8000 rdgs/s | 2000 rdgs/s |
| Memory depth (number of measurements) | 6143 | 2048 |
| GPIB measurements (trigger-measure-transfer) | 250 rdgs/s | 125 rdgs/s |
| Time-stamping of measurements | yes | – |
| Continuous period capture rate | 40 k/s | – |
| Vmax., Vmin. and trigger level resolution | 12.5 mV | 20 mV |
| GPIB interface incl. analog output and TimeView | Standard | Option |
| Rubidium timebase option | yes | – |



Example: High-accuracy frequency measurement of a signal that varies with time.

### PM 6681: Breakthrough Timer/Counter/Analyzer Performance

With its revolutionary technology, the PM 6681 from Fluke sets the new standard for measurement of time intervals, frequency, phase and jitter. PM 6681 is much more than just a timer/counter. Its speed and resolution are comparable to the most accurate time and frequency modulation domain analyzers. Connected to your PC running Fluke's TimeView™ software, PM 6681 fully matches the functionality of a dedicated modulation domain analyzer, at a fraction of the cost. An ultra-high 50 ps single-shot time resolution (20 GHz virtual clock frequency) allows it to reveal and characterize signal anomalies that would otherwise remain hidden-like noise or modulation artifacts.

With the Rubidium reference option built in, it is the most accurate Timer/Counter/Analyzer for the calibration of Frequency, Time intervals or Phase (See Rubidium pages)

### PM 6680B: The Value Leader

For applications that don't demand the PM 6681's sheer performance, check the PM 6680B. This model offers an unmatched combination of performance and price that makes it today's undisputed value leader.

### -Every Measuring Function You Need

No matter what measurement function you need for totalizing, frequency- or time-related measurements, you'll find it in the PM 6681 and the PM 6680B timer/counters. We give you no less than 8 totalizing modes, including simultaneous up/down counting and totalizing over a preset time. We also give you a 4-digit 120 MHz peak-reading voltmeter plus phase, duty factor, $V_{max.}/V_{min.}$, pulse width and rise/fall time.

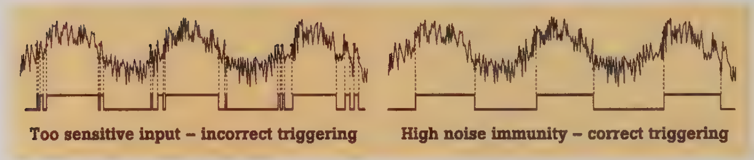
### Capture Any Part of a Complex Signal

These counters' sophisticated arming tools give you plenty of options. You can use the arming function to synchronize the measurement start/stop with an external event. You can choose to arm on the measurement signal itself, or on an external signal. Time-delayed arming can be used, just like delayed sweep on an oscilloscope, to pinpoint a part of the

GPIB
IEEE-488

# High Performance Timer/Counters

## PM 6681 and PM 6680B Timer/Counter/Analyzers



The variable hysteresis mode enables wide band 60 mV to 10V p-p noise suppression.
The trigger hold-off can be used to remove the influence of spurious signals.

signal at any time distance from a synchronization trigger.

A unique delay-by-event function lets you measure on a specific pulse in a pulse train. For example, you can measure the pulse position jitter of the 4th pulse in a sequence. You can also delay trigger hold-off by events, enabling measurement of the time between any two pulses in a pulse stream.

### Correct Triggering

Every counter can trigger correctly on distorted sine waves and square waves. It's the erratic signals that throw them for a loop. The PM 6680B or PM 6681 can trigger on them all, including noisy/distorted, asymmetrical and AM-modulated signals as well as burst signals and those with drifting dc components. What's more, our AUTO-trigger ensures correct, foolproof triggering for any repetitive signal over 100 Hz. It automatically positions the trigger level at 50% amplitude, regardless of duty factor and dc offsets. In rise/fall time measurements, your levels are set at 10% and 90%.

### Noise Immunity

We've also clamped down on noise with features designed to increased noise immunity to prevent noise or interference from causing false triggering. You have a 100 kHz analog low-pass filter for suppressing high frequency noise and spurious interference that is stronger than the input signal itself. Our trigger hold-off eliminates, in time measurements such as distortions as bounces and ringing. As for frequency and ratio measurements, the hold-off serves as a digital filter up to 5 MHz. Finally the PM 6680B and PM 6681 offer unique variable hysteresis mode for noise immunity in frequency measurements. This allows the trigger hysteresis to be set manually, to any value between 60 mV to 10V p-p, thereby suppressing spurious signals, no matter what their frequency.

### Powerful Analysis Tools

Both these new timer/counters are powerful analysis tools with precision trigger facilities to ensure you get exactly the measurements you need: a high trigger resolution, plus trigger hold-off, arming, arming delay and (in PM 6681) continuous counting and time-stamping. But once you've made the measurement, it doesn't stop there. You can go right on to analyze your data, helping you to get exactly the answers you need.

Built-in statistical power shows you data like RMS jitter at the touch of a button. All standard parameters (max., min., mean and standard deviation) are easily available. With fast processing to give you results over hundreds of samples virtually instantly.

For tough analysis problems, you can call on Fluke's TimeView™ PC software that handles time and frequency analysis and advanced statistical processing in the modulation domain. The analysis power of TimeView™ lets you quantify jitter and modulation, discover hidden noise sources, view frequency dynamics, plot agile frequency sources (frequency vs. time), analyze VCO transient responses, view frequency-locked-loop dynamics, *swept and hopping frequencies or pulsed radio frequencies or other burst signals (See TimeView software pages)*

### Built in Processing Power Gives You the Answers You Need

Thanks to their built-in processing functions, PM 6681 and PM 6680B give you the answers you need without using your calculator. You get offset, drift, normalization, scaling and even inversion directly on the display. In TDR measurements you can show distances directly in meters or feet. Or when using transducers, you can display values like gallons/h, RPM or meters/s, or whatever else you prefer.

### High-Speed, High-Resolution Telecom Measurements

With their high resolution/speed performance of 11 digits/s (PM 6681) or 10 digits/s (PM 6680B), these counters are ideal tools for frequency measurements in telecom systems. Both models span a frequency range of up to 4.5 GHz, which enables calibration of microwave links, satellite communications and radar equipment.

You can make frequency measurements accurately and easily, not only on continuous carrier waves, but also on burst signals. This is due to the short measuring times our unique internal burst synchronization and arming functions that enable you to mask instability on the leading edge of the burst.

### Frequency Calibration

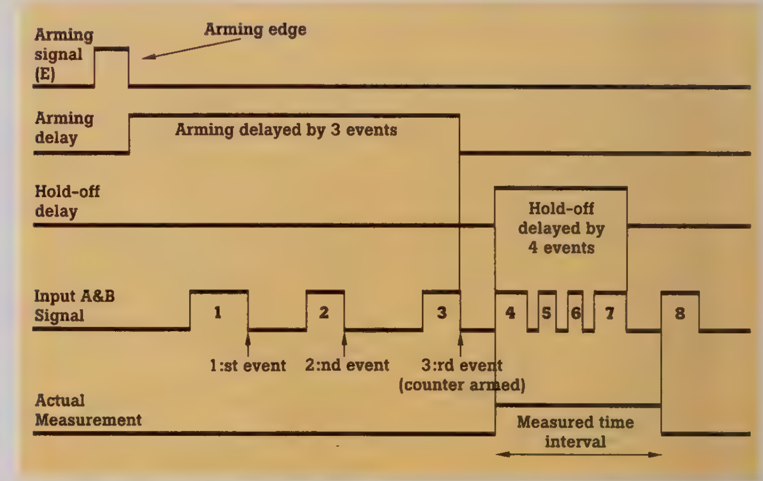
The Rubidium reference of the PM 6681 makes this instrument (together with the PM 6685 Rubidium) the most accurate Timer/Counter/Analyzer for frequency measurements.

### Time Calibration

For the calibration of time the PM 6681 provides leading performance due to the fast 50 ps single shot time resolution (1 ps average) and the accurate trigger sensitivity of 1.25 mV. For monitoring purposes the analog output provides a DC voltage proportional to any three consecutive display digits. So it can be used for strip-chart recording or feedback to an analog control system.

### Phase Calibration

With PM 6681 you can measure phase



Example: Time between pulse no. 4 and no. 8 using Arming and Hold-off with event count delay.

## PM 6681 and PM 6680B Timer/Counter/Analyzers

differences on signals of up to 160 MHz with a resolution better than one-tenth of a degree (0.01° below 30 MHz). This gives you outstanding resolution in measurements like laser positioning and calibration of phase meters.

### High-Speed Data Rate and Full SCPI Programmability for System Builders

Compatibility is the key word for system builders. To protect your investment in application software development, the SCPI standard allows easy hardware reconfiguration without time consuming software rewriting.

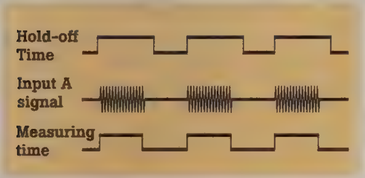
If you want the convenience of the GPIB without the need for complex programming, the PM 6681 and the PM 6680B have an easy-to-use bus learn mode that transfers your manually set functions to the controller, plus macro-programming for fast access to complex measurement set-ups. The maximum speed for individually triggered, fully formatted readings over the IEEE-488 bus (Trigger-Measure-Transfer) is 250 per second.

Another system benefit is the high block measurement rate of 8k measurements/s

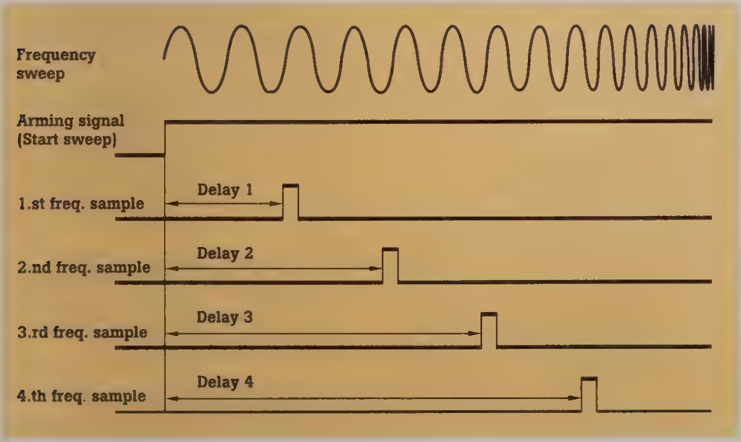
## Specifications

### Measuring Functions

Refer to table 1 for uncertainty information. Inputs A and B can be swapped internally in all modes except Rise and Fall Time.



PRF and burst frequency measurements can easily be made without external gating signals.



### Frequency A, B, C

**Range:**
**Input A (PM 6681):** $10^{-10}$ Hz to 300 MHz
**Input A (PM 6680B):** $10^{-10}$ Hz to 225 MHz
**Input B:** $10^{-10}$ Hz to 100 MHz
**Input C:** Up to 1.3 GHz, 2.7 GHz, 4.2 GHz or 4.5 GHz with options
**Resolution (PM 6681):** 11 digits in 1s measuring time
**Resolution (PM 6680B):** 10 digits in 1s measuring time

### Frequency Burst A, B, C

Frequency and PRF of burst signals can be measured without external control signal and with selectable start arming delay.
**Range:**
**Input A (PM 6681):** Up to 300 MHz
**Input A (PM 6680B):** Up to 160 MHz
**Input B:** Up to 100 MHz
**Input C (PM 6681):** Up to 3 GHz with options
**Start Delay Range (PM 6681)** 200 ns to 1s, 100 ns resolution

### Period A

**Range (PM 6681):** 3.3 ns to $10^{10}$s
**Range (PM 6680B):** 6 ns to $10^{10}$s
**Resolution (PM 6681):** 11 digits in 1s measuring time
**Resolution (PM 6680B):** 10 digits in 1s measuring time

### Ratio A/B, C/B

Range: $10^{-9}$ to $10^{15}$
**Frequency Range:**
**Input A, B:** $10^{-10}$ Hz to 160 MHz
**Input C:** Up to 1.3 GHz, 2.7 GHz 4.2 GHz or 4.5 GHz with options

### Time Interval A to B

**Range:** 0 ns to $10^{10}$s
**Frequency Range:** Up to 160 MHz

### Pulse Width A

**Range:** 3 ns to $10^{10}$s
**Frequency Range:** Up to 160 MHz

### Rise and Fall Time A

**Range:** 3 ns to $10^{10}$s
**Frequency Range:** Up to 160 MHz
**Input Amplitude (PM 6681):** >250 mV p-p
**Input Amplitude (PM 6680B):** >500 mV p-p

### Phase A Relative B

**Range:** -180° to +360°
**Frequency Range:** 0.03 Hz to 160 MHz

### Duty Factor A

**Range:** 0 to 1
**Frequency Range:** 0.11 Hz to 160 MHz

### Totalize A, B

**Range:** 0 to $10^{17}$, 0 to $10^{10}$ in A-B modes
**Frequency Range:** 0 to 160 MHz
**A Gated by B:** Event counting on Input A during the presence of a pulse on Input B. Single or cumulative event counting during set measuring time
**A Start/Stop by B:** Event counting on Input A between two consecutive pulses on Input B
**Manual A-B:** Input A minus Input B event counting with manual start and stop
**Manual/Timed A-B:** Input A minus Input B event counting with manual start. Stop after set measuring time. Time counted from first trigger event on A.

### AC/DC Voltage A, B

**Range:** -50V to +50V
**Frequency Range (PM 6681):** DC, 1 Hz to 100 MHz
**Frequency Range (PM 6680B):** DC, 100 Hz to 100 MHz
**Mode:** V max, V min, V p-p
**Resolution (PM 6681):** 1.25 mV
**Resolution (PM 6680B):** 20 mV
**Gated Volt:** External masking of unwanted signal components such as overshoot

### Input and Output Specifications Inputs A and B (PM 6681)

**Frequency Range:**
**DC-Coupled:** DC to 300 MHz
**AC-Coupled:** 10 Hz to 300 MHz
**Coupling:** AC or DC
**Rise Time PM 6680B** Approx 1.5 ns
**Rise Time PM 6681** Approx 1.1 ns
**Impedance:** 1 MΩ//15 pF or 50Ω (VSWR ≤2:1)
1 MΩ//65 pF or 50Ω with PM 9611/80 rear panel inputs
**Trigger Slope:** Positive or negative
**Channel Inputs:** Separate, common A or swapped
**Sensitivity:** 20 mV rms, <100 MHz
30 mV rms, 100 MHz to 200 MHz
40 mV rms, 200 MHz to 250 MHz
60 mV rms, >250 MHz
**Pulse Width:** >5 ns at 60 mV p-p, >3 ns at 90 mV p-p
**Attenuation:** x1 or x10
**Hysteresis Window (x1):** 20 mV p-p
**Variable Hysteresis A (x1):** 30 mV p-p to 10V p-p up to 120 MHz
**Dynamic Range (x1):** 60 mV p-p to 10V p-p within ±5V window

# High Performance Timer/Counters

## PM 6681 and PM 6680B Timer/Counter/Analyzers

**Trigger Level:** Read-Out on display

**Range:** (x1): -5V to +5V
(x10): -50V to +50V

**Resolution (x1):** 1.25 mV

**Uncertainty (x1):** ±(4 mV + 1% of trigger level)

**AUTO Trigger Level:** Trigger level is automatically set to 50% point of input signal (10% and 90% for Rise/Fall Time, 75% and 25% for variable hysteresis A)

**Frequency:** >1 Hz

**Low Pass Filter A:** 100 kHz fixed. >40 dB attenuation at 1 MHz

**Digital Low Pass Filter:** 1 Hz to 10 MHz using trigger Hold-Off

**Trigger Indicator:** Tri-state LED-indicator

**Max Voltage Without Damage:**

**1 MΩ:** 350V (DC + AC pk) at DC to 440 Hz, falling to 12V rms (x1) and 120V rms (x10) at 1 MHz

**50Ω:** 12V rms

### Inputs A and B (PM 6680B)

**Frequency Range:**

**DC-Coupled:** DC to 225 MHz

**AC-Coupled:** 10 Hz to 225 MHz

**Coupling:** AC or DC

**Impedance:** 1 MΩ//30 pF or 50Ω (VSWR ≤2:1)
1 MΩ//80 pF or 50Ω (with PM 9611/80 rear panel inputs)

**Trigger Slope:** Positive or negative

**Channel Inputs:** Separate, common A or swapped

**Sensitivity:** 20 mV rms, <100 MHz
30 mV rms, 100 MHz to 200 MHz
40 mV rms, >200 MHz

**Pulse Width:** >5 ns at 60 mV p-p, >3 ns at 90 mV p-p

**Attenuation:** x1 or x10

**Hysteresis Window (x1):** 30 mV p-p

**Variable Hysteresis A (x1):** 60 mV p-p to 10V p-p up to 120 MHz

**Dynamic Range (x1):** 60 mV p-p to 10V p-p within ±5V window

**Trigger Level:** Read-Out on display

**Range:(x1): -5.1V to +5.1V**
**(x10): -51V to +51V**

**Resolution (x1):** 20 mV

**Uncertainty (x1):** ±(20 mV + 1% of trigger level)

**AUTO Trigger Level:** Trigger level is automatically set to 50% point of input signal (10% and 90% for Rise/Fall Time, 75% and 25% for variable hysteresis A)

**Frequency:** >100 Hz

**Amplitude:** >150 mV p-p

**Low Pass Filter A:** 100 kHz fixed. >40 dB atten. at 1 MHz

**Digital Low Pass Filter:** 1 Hz to 5 MHz using trigger Hold-Off

**Trigger Indicator:** Tri-state LED-indicator

**Max Voltage Without Damage:**

**1 MΩ:** 350V (DC + AC pk) at DC to 440 Hz, falling to 12V rms (x1) and 120V rms (x10) at 1 MHz

**50Ω:** 12V rms

### Input C options

See PM 6680 family Counter Options

**Input C 1.3 GHz (Option PM 9621)**

**Input C 2.7 GHz (Option PM 9624)**

**Input C 4.5 GHz (Option PM 9625)**

**Input C 4.2 GHz (Option PM 9625B)**

### Input C (Option PM 9621)

**Frequency Range:** 70 MHz to 1.3 GHz

**Prescale Factor:** 256

**Operating Input Voltage Range:**

**70 to 900 MHz:** 10 mV rms to 12V rms

**0.9 to 1.1 GHz:** 15 mV rms to 12V rms

**1.1 to 1.3 GHz:** 40 mV rms to 12V rms

**Amplitude Modulation:** DC to 0.1 MHz: Up to 94% depth
0.1 to 6 MHz: Up to 85% depth
Minimum signal must exceed minimum operating input voltage

**Impedance:** 50Ω nominal, AC coupled, VSWR <2:1

**Max Voltage Without Damage:** 12V rms, pin-diode protected

**Connector:** BNC

### Input C (Option PM 9624)

**Frequency Range:** 100 MHz to 2.7 GHz

**Prescale Factor:** 16

**Operating Input Voltage Range:**

**100 to 300 MHz:** 20 mV rms to 12V rms

**0.3 to 2.5 GHz:** 10 mV rms to 12V rms

**2.5 to 2.7 GHz:** 20 mV rms to 12V rms

**Amplitude Modulation:** As PM9621

**Impedance:** 50Ω nominal, AC coupled, VSWR <2.5:1

**Max Voltage Without Damage:** 12V rms, pin-diode protected

**Connector:** Type N Female

### Input C (Option PM 9625B)

**Frequency Range:** 150 MHz to 4.2 GHz

**Prescale Factor:** 32

**Operating Input Voltage Range:**

**150 to 300 MHz:** 20 mV rms to 1V rms (-21 to +13 dB)

**0.3 to 2.2 GHz:** 10 mV rms to 1V rms (-27 to +13 dB)

**2.2 to 3.5 GHz:** 15 mV rms to 1V rms (-23.5 to +13 dB)

**3.5 to 4.2 GHz:** 25 mV rms to 1V rms (-19 to +13 dB)

**4.2 to 4.5 GHz:** 50 mV rms to 1V rms (-13 to +13 dB)

**Amplitude Modulation:** As PM9621

**Impedance:** 50Ω nominal, AC coupled, VSWR <2.5:1

**Max Voltage Without Damage:** 12V rms, pin-diode protected

**Connector:** Type N Female

### Input C (Option PM 9625)

**Frequency Range:** 150 MHz to 4.5 GHz

**Prescale Factor:** 32

**Operating Input Voltage Range:**

**150 to 300 MHz:** 20 mV rms to 1V rms (-21 to +13 dB)

**0.3 to 2.5 GHz** 10 mV rms to 1V rms (-27 to +13 dB)

**2.5 to 3.7 GHz:** 15 mV rms to 1V rms (-23.5 to +13 dB)

**3.7 to 4.5 GHz:** 25 mV rms to 1V rms (-19 to +13 dB)

**Amplitude Modulation:** As PM9621

**Impedance:** 50Ω nominal, AC coupled, VSWR <2.5:1

**Max Voltage Without Damage:** 12V rms (+34 dBm), pin-diode protected

**Connector:** Type N Female

### Rear Panel Inputs and Outputs

**Reference Input (PM 6681):** 1, 2, 5, or 10 MHz. >200 mV rms signal

**Reference Input (PM 6680):** 10 MHz. >500 mV rms signal

**Reference Output:** 10 MHz. >0.5V rms sinewave into 50Ω load

**Arming Input:** Most measuring functions can be performed.

**Frequency Range (PM 6681):** DC to 100 MHz

**Frequency Range (PM 6680B):** DC to 50 MHz

**Slew Rate:** >2 V/μs

**Trigger Level:** TTL level, 1.4V nominal

**Trigger Slope:** Positive or negative

**Gate Output:** Gate open/gate closed signal output

**Trigger Level Outputs:** Outputs for channel A and B trigger levels

**Probe Compensation Outputs:** Outputs for channel A and B to adjust for best pulse response when using probes for counter input

**Analog Output:** 0 to 4.98V proportional to 3 selected digits

### Auxiliary Functions

### Trigger Hold-Off

**Time Delay Range (PM 6681):** 60 ns to 1.34s, 10 ns resolution

**Time Delay Range (PM 6680B):** 200 ns to 1.6s, 100 ns resolution

**Event Delay Range B (PM 6681):** 2 to $2^{24}$-1, max. 100 MHz

**Event Delay Range B (PM 6680B):** 2 to $2^{24}$-1, max. 20 MHz

### External Arming

**Time Delay Range B, E:** 200 ns to 1.6s, 100 ns resolution

**Event Delay Range B:** 2 to $2^{24}$-1, max. 20 MHz

### Statistics

**Functions:** Maximum, Minimum, Mean and Standard Deviation

**Sample Size (PM 6681):** 1 to 2 x $10^{-9}$ samples

**Sample Size (PM 6680B):** 1 to 65535 samples

### Mathematics

**Functions:** (K*X+L)/M and (K/X+L)/M. X is current reading and K, L and M are constants; set via keyboard or as frozen reference value ($X_0$) or as value from preceding measurement ($X_{n-1}$)

### Other Functions

**Measuring Time (PM 6681):** Single cycle,

# High Performance Timer/Counters

## PM 6681 and PM 6680B Timer/Counter/Analyzers

### Measurement Uncertainties

| Measuring Function | Random Uncertainty rms | Systematic Uncertainty |
|---|---|---|
| Time Interval<br>Pulse Width<br>Rise/Fall Time | $\frac{\sqrt{(QE)^2 + (\text{Start Trigger Error})^2 + (\text{Stop Trigger Error})^2}}{\sqrt{N}}$<br>or min.: 1 ps for PM 6681, 100 ps for PM 6680B | ±Trigger Level Timing Error<br>±500 ps Systematic Error (PM 6681)<br>±1 ns Systematic Error (PM 6680B)<br>±Time Base Error x Time Interval |
| Frequency<br>Period | $\frac{\sqrt{(QE)^2 + 2 \times (\text{Start Trigger Error})^2}}{\text{Measuring Time}} \times$ Frequency or Period | ±Time Base Error × Freq. or Period |
| Ratio f1/f2 | $\frac{\sqrt{(\text{Prescaler Factor})^2 + 2\times(f_1 \times \text{Start Trigger Error of } f_2)^2}}{f2 \times \text{Measuring Time}}$ | |
| Phase | $\frac{\sqrt{(QE)^2+(\text{Start Trigger Error})^2+(\text{Stop Trigger Error})^2}}{\sqrt{N}}$ x Freq. x 360°<br>or min.: (1 ps for PM 6681, 100 ps for PM 6680B) x Freq. x 360° | ±Trigger Level Timing Error°<br>±500 ps Sys. Error x Freq. x 360° (PM 6681)<br>± 1 ns Sys. Error x Freq. x 360° (PM 6680B) |
| Duty Factor | $\frac{\sqrt{(QE)^2+(\text{Start Trigger Error})^2+(\text{Stop Trigger Error})^2}}{\sqrt{N}}$ x Frequency<br>or min.: (1 ps for PM 6681, 100 ps for PM 6680B) x Freq. | ±Trigger Level Timing Error x Freq.<br>±500 ps Sys. Error x Freq. (PM 6681)<br>±1 ns Syst. Error x Freq. (PM 6680B) |

Table 1: Measurement Uncertainties

| Measurement Rate* | PM 6681 | PM 6680B |
|---|---|---|
| Via GPIB | 250 readings/s | 125 readings/s |
| To Internal Memory: | 8k readings/s | 2k readings/s |
| Internal Memory Size (PM 6681)* | Up to 6100 readings | |
| Internal Memory Size (PM 6680B)* | Up to 2600 readings | |
| Data Output: | ASCII, IEEE double precision floating point | |

### TimeView™ Time and Frequency Analysis Software

**Range**

TimeView runs on an IBM PC/AT or compatible with VGA/EGA monitor.

### Data Capture Modes and Measurement Rate*

| Range | PM 6681 | PM 6680B |
|---|---|---|
| Free Running Measurement: | 8k readings/s | 2k readings/s |
| Repetitive Sampling: | Up to 10 MHz | Up to 10 MHz |
| Continuous Single-Period: | Up to 40k readings/s<br>(200 ns resolution) | N/A |
| Waveform Capture: | Yes | N/A |
| Data Analysis Features: | Measurement data vs time<br>FFT Graph<br>Root Allan Variance<br>Smoothing function<br>Zoom function<br>Cursor measurements<br>Distribution Histogram<br>Setup and Measurement Data Archive and Printing | |

* Depending on measurement function and internal data format

80, 160, 320, 640, 1280 ns and 20 µs to 20s (or to 400s for some functions)

**Measuring Time (PM 6680B):** Single cycle, 0.8, 1.6, 3.2, 6.4, 12.8 µs and 50 µs to 20s (or to 400s for some functions)

**Display Hold:** Freezes measuring result, until a new measurement is initiated via Restart

**Settings:** 20 instrument setups can be saved and recalled from internal non-volatile memory. 10 can be user protected.

**Auxiliary Menu:** Gives access to additional functions

**Display:** 10-digit LCD with high-luminance backlight

### GPIB Interface

**Programmable Functions:** All front panel accessible functions

**Compatibility:** IEEE 488.2-1987, SCPI 1991.0

**Interface Functions:** SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, E2

**Time Stamping (PM 6681):** 125 ns resolution

### Random Uncertainties

**(QE) Quantization Error (PM 6681):**

**10°C to 40°C:** 50 ps rms

**0 to 10°C and 40 to 50°C:** 75 ps rms

**(QE) Quantization Error (PM 6680B):**

**0°C to 55°C:** 250 ps rms

**(N) Number of samples (PM 6681):**

**Frequency <12 kHz:** Measuring Time × Frequency/2

**Frequency >12 kHz:** Measuring Time × 6000

**(N) Number of samples (PM 6680B):**

**Frequency <2 kHz:** Measuring Time × Frequency/2

**Frequency >2 kHz:** Measuring Time × 1000

**Start/Stop Trigger Errors:**

$$\frac{\sqrt{(\text{Vnoise-input})^2+(\text{Vnoise-signal})^2}}{\text{Signal slew rate (V/s) at trigger point}} \text{ rms}$$

$(\text{Vnoise-input})^2+(\text{Vnoise-signal})^2$/Signal slew rate (V/s) at trigger point rms

**V noise-input (PM 6681):** 100 µV rms typical

**V noise-input (PM 6680B):** 200 µV rms typical

**V noise-signal:** The rms noise of the input signal

### Systematic Uncertainties

**Trigger Level Timing Error**

Time Interval, Rise/Fall Time, Pulse Width, Duty Factor (x1):

Trigger Level Timing Error = TLU x (1/Sx + 1/Sy) ±0.5 x Hyst. x (1/Sx + 1/Sy)

Where:

**Sx** = Slew rate at start trigger point in V/s

**Sy** = Slew rate at stop trigger point in V/s

**TLU** = Trigger Level Uncertainty for each model in Volt

**Hyst.** = Hysteresis Window for each model in Volt

**Hyst.** = 0 for Time Interval and Rise/Fall Time for PM 6681

Phase, sinewave signals and trigger levels 0V (x1):

Trigger Level Timing Error (PM 6681) =

# High Performance Timer/Counters

## PM 6681 and PM 6680B Timer/Counter/Analyzers

### Time Base Options

| Model Options | /–1–<br>Standard | /–2–<br>PM 9678B<br>TCXO | /–4–<br>PM 9690<br>Oven | /–5–<br>PM 9691<br>Oven | /–7–<br>Rubidium<br>(PM 6681R only) |
|---|---|---|---|---|---|
| **Standard Stability Against**<br>Aging: /24h | n.a. | n.a. | $< 1 \times 10^{-9}$* | $< 5 \times 10^{-10}$* | $< 2 \times 10^{-12}$ |
| /month | $< 5 \times 10^{-7}$ | $< 1 \times 10^{-7}$ | $< 2 \times 10^{-8}$ | $< 1 \times 10^{-8}$ | $< 5 \times 10^{-11}$** |
| /year | $< 5 \times 10^{-6}$ | $< 5 \times 10^{-7}$ | $< 1 \times 10^{-7}$ | $< 7.5 \times 10^{-8}$ | $< 5 \times 10^{-10}$ |
| Temperature 0 to 50°C ref to +23°C | $< 1 \times 10^{-5}$ | $< 1 \times 10^{-6}$ | $< 1.5 \times 10^{-8}$ | $< 5 \times 10^{-9}$ | $< 3 \times 10^{-10}$ |
| Line Voltage ±10% | $< 1 \times 10^{-8}$ | $< 1 \times 10^{-9}$ | $< 5 \times 10^{-10}$ | $< 5 \times 10^{-10}$ | $< 1 \times 10^{-11}$ |
| Warm-up time to reach $10^{-7}$ of final value | n.a. | n.a. | < 15 min | < 15 min | < 6 min. to reach $10^{-9}$ |

* after 48 hours of continuous operation
** after 1 month of continuous operation

= [0.2/V pk of A + 0.2/V pk of B] °
Trigger Level Timing Error (PM 6680B) = = [0.3/V pk (A) + 0.3/V pk (B)] ° ±[0.9/V pk (A) - 0.9/V pk (B)] °
Where:
V pk (A) = Input A peak voltage in Volt
V pk (B) = Input B peak voltage in Volt

### Display Resolution

**LSD Displayed** Unit value of the least significant digit displayed. All calculated LSDs should be rounded to the nearest decade (e.g. 0.3 Hz is rounded to 0.1 Hz, 5 Hz is rounded to 10 Hz.) and cannot exceed the 12th digit.

### Frequency and Period

$$\frac{50 \text{ ps x Frequency or Period}}{\text{measuring time}}$$

$$\frac{500 \text{ ps x Frequency or Period}}{\text{measuring time}}$$

### Time Interval, RT, FT, PW

**LSD Displayed (PM 6681)** 50 ps/$\sqrt{N}$
**LSD Displayed (PM 6680B)** 500 ps/$\sqrt{N}$

### Duty Factor

**LSD Displayed** 1 x $10^{-6}$

### Phase

**LSD Displayed** 0.01°

### Ratio $f_1/f_2$

$$\frac{\text{Prescaler Factor}}{f_2 \text{ x measuring time}}$$

### Environmental Data

**Operating Temp (PM 6681):** 0°C to +50°C
**Operating Temp (PM 6680B):** 0°C to 55°C
Fan option is required when:
1. Ambient temp. >50°C
2. Internal rack temp. >45°; while mounted with no free air convection space and oven oscillator PM 9690 or PM 9691 is installed
**Storage Temp:** -40°C to +70°C
**Vibration:** 3G at 55 Hz per MIL-T-28800D
**Shock:** Half-sine 40G per MIL-T-28800D. Bench handling. Shipping container.
**Reliability:** MTBF 30 000 h (calculated)
**Safety:** IEC 1010 Class 1, CSA 22.2, No. 231, EN61010-1, CE
**EMC:** EN 55011 ISM Group 1, Class B; EN 50082-2; FCC Part 15J Class A, CE

### Power Requirements

90V rms to 265V rms, 45 Hz to 440 Hz, 35W

### Mechanical Data

**Width:** 315 mm (12.4 in),
**Height:** 86 mm (3.4 in),
**Depth:** 395 mm (15.6 in)
**Weight:** Net 4 kg (8.5 lb), Shipping 7 kg (15 lb)

## PM 6681 and PM 6680B Timer/Counter/Analyzers

## Ordering Information

### Basic Models

**PM 6680B/011** 225 MHz, 250 ps Timer/Counter/Analyzer including Standard Time Base *$1780*

**PM 6681/016** 300 MHz, 50 ps Timer/Counter/Analyzer including Standard Time Base, External Reference Frequency Multiplier (1, 2, 5, 10MHz), GPIB-interface and Time & Frequency Software, TimeView *$3190*

### Rubidium Reference Basic Model

**PM 6681R/076** 300 MHz Frequency Reference/Counter/Calibrator including GPIB-interface and Time & Frequency Software, TimeView (see special Rubidium Counter Section)

### Input Frequency Options

**PM 668-/4—** 1.3 GHz Input C (PM 9621/001) *$595*

**PM 668-/6—** 2.7 GHz Input C (PM 9624/001) *$840*

**PM 668-/7—** 4.5 GHz Input C (PM 9625/001) *$3600*

**PM 668-/8—** 4.2 GHz Input C (PM 9625B/201) *$2500*

**Time Base Options**

**PM 668-/-2-** TCXO (PM 9678/201) *$325*

**PM 668-/-4-** High Stability Oven Time Base (PM 9690/011) *$890*

**PM 668-/-5-** Very High Stability Oven Time Base (PM 9691/011) *$1095*

**PM 668-/-8-** Standard Time Base plus External Reference Frequency Multiplier (1, 5, 10 MHz) (PM 9697/001) (PM 6680B only) *$250*

**GPIB-Interface option**

**PM 6680B/—6** GPIB-Interface (PM 9626/001), including Time & Frequency software: Timeview *$100*

**Example Ordering Configuration**

To order the PM 6681 300 MHz, 50 ps version with the 2.7 GHz input C and TCXO Time Base, select the complete Model Number: PM 6681/626.

**Included with Instrument**

One-year product warranty, line cord, operator manual, and Certificate of Calibration Practices.

### Options and Accessories

**PM 9611/801** Rear Panel Inputs (Front inputs disconnected) *$145*

**PM 9621/001** 1.3 GHz Input C *$595*

**PM 9624/001** 2.7 GHz Input C *$840*

**PM 9625/001** 4.5 GHz Input C *$3600*

**PM 9625B/201** 4.2 GHz Input C *$2500*

**PM 9678/201** TCXO Time Base *$325*

**PM 9690/011** High Stability Oven Time Base *$890*

**PM 9691/011** Very High Stability Oven Time Base *$1095*

**PM 9697/001** ** External Reference Frequency Multiplier (1, 5, 10 MHz) *$250*

**PM 9626/001** * GPIB-Interface for PM 6680B *$650*

**PM 9628/001** Cooling Fan for PM 6680B *$160*

**PM 9622/001** Rack-Mount Kit *$170*

**PM 9627/001** Carrying Case *$150*

**PM 9020/001** 200 MHz 10:1 probe 1MΩ/30pF (for PM 6680B) *$110*

**PM 8929/191** 500 MHz 10:1 probe 1MΩ/15pF *$175*

**PM 8911/091** 1.5 GHz 10:1 Probe 50Ω for C channel option (BNC) *$240*

* PM 9626 GPIB-Interface includes Analog Output and TimeView Analysis software

** PM 9697 External Reference Frequency Multiplier can be used only with the standard Time Base of PM 6680B

When ordered together with the basic counter, options are factory installed. Options ordered separately can be customer retrofitted, except PM 9611/80 Rear Panel Inputs.

### Manuals

**PM 6680** Operator* P/N 112810 *$100*

**PM 6680** Programming* P/N 112771 *$145*

**PM 6680** Service P/N 949342 *$145*

**PM 6681** Service P/N 105236 *$170*

*No charge with purchase of unit

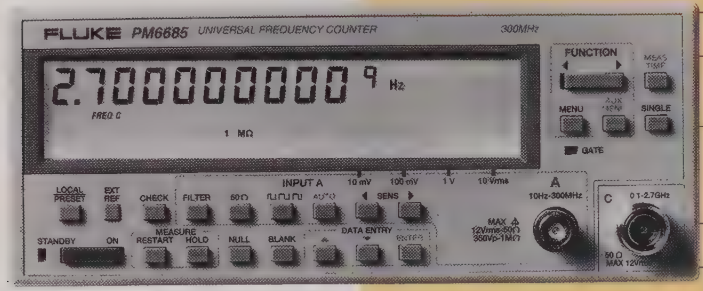
## Customer Support Services

### Factory Warranty

One-year product warranty.
Five-year warranty on Rubidium Element.

# High Performance Frequency Counters

## PM 6685 Universal Frequency Counter



- 300 MHz basic input range; options for 1.3 GHz, 2.7 GHz, 4.2 GHz or 4.5 GHz
- Displays 10 digits in a second
- High stability timebases: up to 5 x $10^{-10}$/24 h
- Smart AUTO trigger eliminates guesswork, provides error free triggering
- Analog Bar Graph displays signal strength and input sensitivity to assist instrument setup and RF tuning applications
- Nulling function lets you use any value as input reference
- Connect and go convenience for testbench and field use
- Digit blanking function to eliminate distracting or insignificant digits in your readings
- Optional IEEE (SCPI) interface
- Optional Battery pack

### Cal Lab Performance in the Field

The PM 6685 frequency counter from Fluke brings cal lab accuracy to field measurements. With 10 digits per second resolution, plus overflow (11th and 12th digits), it delivers high accuracy measurements instantly. The PM 6685 is easy to use, compact and most important of all it has today's smartest input triggering for frequency measurements. The battery option for the PM 6685 maintains oven stability for 20 hours, giving you instant oven performance even after long transportation.

### Built-in Capabilities Simplify Tricky Measurements ....

The PM 6685's built-in intelligence eliminates a lot of button pushing. Just plug it in, and it automatically selects the optimum trigger level and input sensitivity for excellent noise immunity. Or do you need to look at digital control signals? Just push a button to measure pulsewidth or duty factor. The PM 6685 automatically changes the sensitivity for maximum accuracy.

The easy to read bargraph gives you instant feedback on whether the signal level is adequate. A built in NULL function enables measurements relative to the value on the display, or to a manually entered numerical value great for fine tuning and adjustment! When you don't need the full 10 digits the "Digit Blanking" function lets you eliminate irrelevant digits one by one. This is especially useful when measuring unstable signal sources.

GPIB
IEEE-488

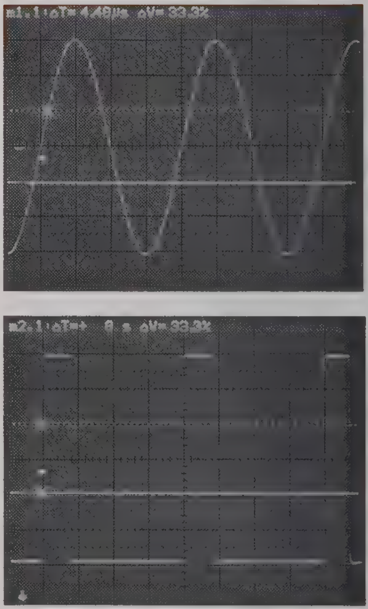
Need to measure the frequency of non continuous waves? You can measure burst frequencies or the PRF (pulse repetition frequency) of burst signals. The PM 6685 automatically synchronizes using its "Single Line" burst frequency mode. This unique capability lets you acquire and measure frequency burst signals without the need for external gating signals. If an external arming signal is available, the PM 6685 lets you do even more. A unique Arming Delay function lets you delay the arming point anywhere from 200 ns to 1.6s in 100 ns increments.

### Automatic Protection from Input Damage

The smart PM 6685 always checks input signal levels before it allows you to switch from 1 MW to 50W input termination. If the signal level is too high, the input remains in the 1 MW setting, and an "Overload" message is displayed. This prevents damage that could be caused by accidentally switching to the lower impedance input when measuring a high voltage signal.

### The Intelligent Choice in Frequency Counters

A frequency counter is just a tool to make your job easier. So why not choose the counter that handles the tedious tasks for you? The counter that delivers cal lab performance in the field. The counter that updates so fast, you can make adjustments in real time. The counter that's so versatile, you can use it anywhere. The counter that eliminates the guesswork. The PM 6685 frequency counter from Fluke. Just connect and go!



The unique AUTO-trigger sets the width of the trigger hysteresis (noise immunity) band to a third of the input amplitude. Simultaneously it centers the hysteresis band just at the middle of the input signal. Regardless of the amplitude and waveform duty cycle, error-free triggering with a high noise immunity is thereby guaranteed.

## Specifications

### Technical Specifications

#### Measuring Functions

Refer to table 1 for measurement uncertainty information.

#### Frequency A, C

**Range**
Input A: 10 Hz to 300 MHz
Input C:
  70 MHz to 1.3 GHz (PM 9621)
  100 MHz to 2.7 GHz (PM 9624)
  150 MHz to 4.2 GHz (PM 9625B)
  150 MHz to 4.5 GHz (PM 9625)
**Resolution:** 10 digits/s measurement time

#### Burst Frequency A

**Frequency Range:** 100 Hz to 160 MHz
**PRF Range:** 1 Hz to 100 kHz
**Pulse Width Range:** 1 µs to 50 ms, min. 3 periods of this signal

#### Period A

**Range:** 6 ns to 100 ms
**Resolution:** 10 digits/s measurement time

#### Ratio A/E, C/A

**Range:** $10^{-7}$ to $10^{10}$
**Frequency Range:**
Input A: 10 Hz to 160 MHz
Input E: 10 Hz to 50 MHz
Input C:
  70 MHz to 1.3 GHz (PM 9621)
  100 MHz to 2.7 GHz (PM 9624)
  150 MHz to 4.2 GHz (PM 9625B)
  150 MHz to 4.5 GHz (PM 9625)

#### Pulse Width A

**Range:** 3 ns to 10 ms
**Frequency Range:** 50 Hz to 160 MHz
**Voltage Range:** 100 mV p-p to 70V p-p

#### Duty Factor A

**Range:** 0 to 1
**Frequency Range:** 50 Hz to 160 MHz
**Voltage Range:** 100 mV p-p to 70V p-p

#### Totalize A

Event counting on input A with manual start and stop
**Range:** 0 to $10^{17}$
**Frequency range:** 0 to 160 MHz

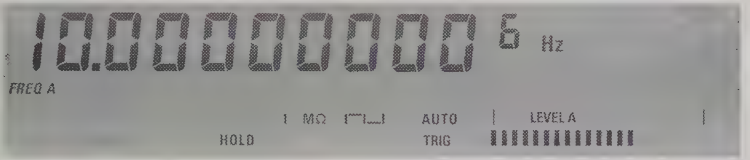
### Input and Output Specifications

#### Input A

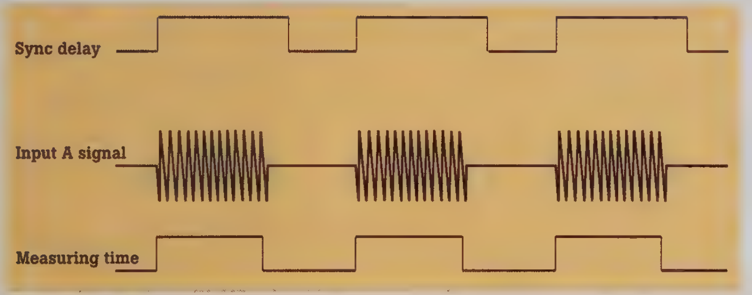
**Frequency range:** 10 Hz to 300 MHz
**Coupling:** AC
**Impedance:** 1 MΩ//25 pF or 50Ω, VSWR < 2:1

10.000000000 6 Hz
FREQ A
1 MΩ
HOLD
SENSITIVITY A

In manual-trigger mode, a bar-graph shows the set sensitivity (3 dB/bar).



In AUTO-trigger mode, a bar-graph shows the input signal amplitude. This input level monitor is a convenient feature to monitor that an adequate signal level is present for error-free triggering.



PRF and burst frequency measurements can easily be made without external gating signals.

**Sensitivity:**
Sinewave:
  10 mV rms, 10 Hz to 50 MHz
  15 mV rms, 50 MHz to 100 MHz
  20 mV rms, 100 MHz to 150 MHz
  30 mV rms, 150 MHz to 200 MHz
  50 mV rms, 200 MHz to 300 MHz
**Pulse:** 50 mV p-p, 3 ns minimum pulse width
**Dynamic Range:** 30 mV p-p to 70V p-p
**Manual Trigger:**
**Sensitivity Range:** 10 mV rms to 10V rms, variable in 3 dB steps, indicated on a bar graph
**Trigger Level:** Selectable for optimum triggering on waveforms with duty factors <0.25, 0.25 to 0.75 and >0.75
**Trigger Slope:** Positive or negative
**Auto Trigger:** Automatic setting of input signal conditioning circuits for optimum triggering on different amplitudes and waveforms
**Frequency:** Minimum 50 Hz
**Sensitivity Range:** 10 mV rms to 25V rms
**Signal Monitor:** A bar graph displays actual input signal level in 3 dB steps, 10mV rms to 10V rms
**Low Pass Filter:** 100 kHz nominal 3 dB point. Minimum 40 dB attenuation at 1 MHz.

#### Damage Level

**1 MΩ:** 350V (dc + ac peak) at dc to 440 Hz, falling to 12V rms at 1 MHz and above
**50Ω:** 12V rms

#### Input C (Option PM 9621)

**Frequency Range:** 70 MHz to 1.3 GHz
**Prescaler Factor:** 256
**Operating Input Voltage Range:**
**70 to 900 MHz:** 10 mV rms to 12V rms
**900 to 1100 MHz:** 15 mV rms to 12V rms
**1100 to 1300 MHz:** 40 mV rms to 12V rms
**Amplitude Modulation:**
dc to 0.1 MHz: Up to 94% depth
0.1 to 6 MHz: Up to 85% depth
Minimum signal must exceed minimum operating input voltage
**Impedance:** 50Ω nominal, ac coupled, VSWR <2:1
**Damage Level:** 12V rms, pin-diode protected
**Connector:** BNC

#### Input C (Option PM 9624)

**Frequency Range:** 100 MHz to 2.7 GHz
**Prescaler Factor:** 16
**Operating Input Voltage Range:**
**100 MHz to 300 MHz:** 20 mV rms to 12V rms
**0.3 GHz to 2.5 GHz:** 10 mV rms to 12V rms
**2.5 GHz to 2.7 GHz:** 20 mV rms to 12V rms
**Amplitude Modulation:** As PM 9621
**Impedance:** 50Ω nominal, ac coupled, VSWR <2,5:1
**Damage Level:** 12V rms, pin-diode protected
**Connector:** Type N Female

### Input C (Option PM 9625B)

**Frequency Range:** 150 MHz to 4.2 GHz

**Prescaler Factor:** 32

**Operating Input Voltage Range:**

**150 to 300 MHz:**
20 mV rms to 1V rms (−21 to +13 dB)

**0.3 to 2.2 GHz:**
10 mV rms to 1V rms (−27 to +13 dB)

**2.2 to 3.5 GHz:**
15 mV rms to 1V rms (−23.5 to +13 dB)

**3.5 to 4.2 GHz:**
25 mV rms to 1V rms (−19 to +13 dB)

**4.2 to 4.5 GHz:**
50 mV rms to 1V rms (−13 to +13 dB)

**Amplitude Modulation** As PM 9621

**Impedance:** 50Ω nominal, AC coupled, VSWR <2.5:1

**Max Voltage Without Damage:** 12V rms, pin-diode protected

**Connector:** Type N Female

### Input C (Option PM 9625)

**Frequency Range:** 150 MHz to 4.5 GHz

**Prescaler Factor:** 32

**Operating Input Voltage Range:**

**150 to 300 MHz:** 20 mV rms to 1V rms (−21 to +13 dBm)

**0.3 to 2.5 GHz:** 10 mV rms to 1V rms (−27 to +13 dBm)

**2.5 to 3.7 GHz:** 15 mV rms to 1V rms (−23.5 to +13 dBm)

**3.7 to 4.5 GHz:** 25 mV rms to 1V rms (−19 to +13 dBm)

**Amplitude Modulation:** As PM 9621

**Impedance:** 50Ω nominal, ac coupled, VSWR 2,5:1 typical

**Damage Level:** 12V rms (+34 dBm), pin-diode protected

**Connector:** Type N Female

### External Reference Input D

The use of external reference is indicated on the display

**Input Frequency:** 10 MHz standard. 1 MHz and 5 MHz with optional Reference Frequency Multiplier (PM 9697).

**Voltage Range:** 500 mV rms to 10V rms

**Impedance:** Approx 1 kΩ (ac coupled)

### Input E

Used in Ratio A/E and external arming/gating modes

**Frequency Range:** DC to 50 MHz

**Pulse Width:** 10 ns minimum

**Slew Rate:** 2V/µs minimum

**Trigger Level:** TTL level, 1.4V nominal

**Trigger Slope:** Positive or negative

**Impedance:** Approx 2 kΩ (dc coupled)

**Damage Level:** ±25V peak

### Reference Output G

**Frequency:** 10 MHz, sine wave

**Output Level:** >0.5V rms into 50Ω load, >0.7V rms into high impedance load

**Coupling:** AC

## Auxiliary Functions

### External Arming/External Gate

External signal on input E can be used to inhibit start and/or stop triggering. Stop arming is not applicable to Pulse Width and Duty Factor measuring modes.

**Start Arming Delay:** OFF or 200 ns to 1.6s in 100 ns steps

### Nulling/Frequency Offset

Nulling enable measurements to be displayed relative to a previously measured value or any frequency offset value entered via front panel keys

### Other Functions

**Measuring Time:** Single cycle, 0.8, 1.6, 3.2, 6.4, 12.8 µs and 50 µs to 20s, (up to 400s, depending on measuring function and input signal frequency)

**Local/Preset:** Go to local function in remote mode, or preset counter to default setting in local mode

**Restart:** Starts a new measurement

**Display Hold:** Freezes measuring result. Start and stop of the totalization in TOT A MAN.

**Check:** Applies 10 MHz to the measuring logic

**Display:** LCD with high-luminance backlight

**Number of Digits:** 10 digits plus exponent

**Blanking:** Least significant digits can be blanked

**Bar Graph:** Displays input signal level or sensitivity setting in 3 dB steps from 10mV rms to 10V rms

**Auxiliary Menu:** The following functions are available from the AUX MENU and via the GPIB interface

**Save/Recall:** 19 complete instrument settings. 10 settings can be user protected

**GPIB-Address:** Read and temporarily change via front panel keys. (Set new address on rear panel switch.)

**Burst Frequency:** A or C (PM 9625) input, set synchronization delay time

**PRF:** A or C (PM 9625) input, set synchronization delay time

**Trigger Slope:** Positive or negative slope

**Arming Start:** Positive or negative slope, set start arming delay time

**Arming Stop:** Positive or negative slope

**Null:** Read and change stored offset frequency

**Display Overflow:** Display of the 11th and 12th digits

**Test:** Select selftests

**Program Version:** Display instrument and GPIB program versions

**Time Out:** OFF or 100 ms to 25.5s in 100 ms steps

**Analog Output:** Select digits and scaling factor

**Display Backlight:** On/off

### Measurement Uncertainties

| Measuring Functions | Random Uncertainty rms | Systematic Uncertainty | LSD Displayed |
|---|---|---|---|
| Frequency<br>Period | $\pm \frac{\sqrt{(250\ \text{ps})^2 + (\text{Trigger Error})^2}}{\text{Measuring Time}} \times \text{Freq. or Per.}$ | ± Time Base Error × Frequency or Period | $\frac{250\ \text{ps} \times \sqrt{2}\ \text{Freq. or Period}}{\text{Measuring Time}}$ |
| Ratio $f_1/f_2$ | $\pm \frac{\sqrt{(\text{Prescaler factor})^2 + (f_1 \times \text{Trigger Error of } f_2)^2}}{f_2 \cdot \text{Measuring Time}}$ | | $\frac{\text{Prescaler Factor}}{f_2 \times \text{Measuring Time}}$ |
| Phase<br>(Auto Trigger) | $\pm \sqrt{(250\ \text{ps})^2 + (\text{Trigger Error})^2}$ | ± Time Base Error × Pulse Width<br>± 0.5 × Transition Time ± 1.5 ns | 100 ps |
| Duty Factor<br>(Auto Trigger) | $\pm \sqrt{(250\ \text{ps})^2 + (\text{Trigger Error})^2} \times \text{Frequency}$ | ± (0.5 × Transition Time + 1.5 ns) × Frequency | $1 \times 10^{-6}$ |

Table 1. Measurement Uncertainties and LSD Displayed.

## PM 6685 Universal Frequency Counter

### Random Uncertainty

Random uncertainty is due to quantization error, short-term Time Base stability, internal noise and input signal noise. The random uncertainty can be reduced by increasing the measurement time.

**Trigger Error:** Internal noise and input signal noise, expressed as an rms Trigger Error.

$$\text{Trigger Error} = \frac{1.4 \times \sqrt{(e_{amp})^2 + (e_n)^2}}{\text{Signal slew rate (V/s) at trigger point}}$$

Where:

$e_{amp}$ = rms input amplifier noise (250 µV rms typical)

$e_n$ = rms noise of the input signal over a 300 MHz bandwidth

### Systematic Uncertainty

See crystal oscillator specifications for aging and possible frequency deviation due to the oscillator's temperature dependency.

### LSD Displayed

Unit value of Least Significant Digit (LSD) displayed. After calculation, the LSD value is rounded to the nearest decade before display (for example >0.5 Hz will be 1 Hz and $^2$0.5 Hz will be 0.1 Hz). LSD blanking is available to reduce displayed resolution. Measuring times >1s can give significance in >10 digits. The 11th and 12th digits can be displayed using the display overflow function.

### Battery Unit (Option PM 9623)

The PM 9623 is a rechargeable battery unit for mounting inside the counter.

**Battery Type:** Sealed lead-acid cells

**Battery Capacity:** At 25°C

**Standby Mode:** Typically 20 hours with Oven Time Base

**Operating Mode:** Typically 3 hours without options, 2.5 hours with Oven Time Base, and 2 hours with Oven Time Base and Input C

**Recharge Time:** Typically 8 hours in standby mode

**Battery Protection:** Overcharge and deep discharge protection

**External DC:** 12V to 24V via socket on rear panel (16V to 24V to charge internal battery)

**Line Failure Protection:** Counter automatically switches to internal battery or external dc when the line voltage falls below 90V ac

### Temperature

**Operating:** 0°C to +40°C

**Storage:** −40°C to +50°C

**Weight:** 1.5 kg (3.3 lb)

### GPIB (Option PM 9626/02)

**Programmable Functions:** All front panel and AUX MENU functions

**Compatibility:** IEEE 488.2-1987, SCPI 1991.0

**Interface Functions:** SH1, AH1, T6, L4, SR1, RL1, DC1, DT1, E2

**Maximum Measurement Rate to Internal Memory:** 200 to 1600 readings/s, depending on measurement function and internal data format

**Internal Memory Size:** 764 to 2600 readings, depending on measurement function and internal data format

**Maximum Bus Transfer Rate:** 150 to 1000 readings/s, depending on internal data format and output data format

**Data Output Format:** ASCII, IEEE double precision floating point

**Time Out:** Off or 100 ms to 25.5s in 100 ms steps

**Analog Output:** 0 to 4.98V in 20 mV steps, derived from three consecutive digits selected from the measurement result

**Output Impedance:** 200Ω

## General Specifications

### Environmental Conditions

**Temperature**

**Operating:** 0°C to +50°C

Fan option PM 9628/02 is required when ambient temperature >45°C and oven oscillator PM 9690 or PM 9691 is installed

**Storage:** −40°C to +70°C

**Humidity:** 95% RH, 0°C to 30°C

**Altitude**

**Operating:** Up to 4600m (15000 ft)

**Non-operating:** Up to 12000m (40000 ft)

**Vibration:** 3G at 55 Hz per MIL-T-28800D, Class 3, Style D

**Shock:** Half-sine 40G per MIL-T-28800D, Class 3, Style D. Bench handling. Shipping container.

**Reliability:** MTBF 30 000 hours

**Safety:** IEC 1010 Class 1, CSA 22.2 No. 231, EN61010, CE

**EMC:** EN 55011, VDE 0871 Level B, FCC Part 15J Class A, CE

### Power Requirements

**AC:** 90 to 265V rms, 45 to 440 Hz, max 30W

**DC (PM 9623):** Internal battery or external 12 to 24V dc, max 2A

### Mechanical Data

**Size:** 86 mm H × 210 mm W × 395 mm D (3.4 in H × 8.25 in W × 15.6 in D)

**Weight:** Net 3.2 kg (7 lb); shipping 5.5 kg (12 lb)

## Options

### Time Base Options

| Model Options / Standard Stability against | /–1–<br>Standard | /–2–<br>PM 9678B<br>TCXO | /–4–<br>PM 9690<br>Oven | /–5–<br>PM 9691<br>Oven | /–7–<br>Rubidium |
|---|---|---|---|---|---|
| Aging: /24h<br>/month<br>/year | N/A<br>$<5 \times 10^{-7}$<br>$<5 \times 10^{-6}$ | N/A<br>$<1 \times 10^{-7}$<br>$<5 \times 10^{-7}$ | $<1 \times 10^{-9}$*<br>$<2 \times 10^{-8}$<br>$<1 \times 10^{-7}$ | $<5 \times 10^{-10}$*<br>$<1 \times 10^{-8}$<br>$<7.5 \times 10^{8}$ | $<2 \times 10^{12}$<br>$<5 \times 10^{-11}$**<br>$<5 \times 10^{-10}$ |
| Temperature 0 to 50°C ref. to + 23°C | $<1 \times 10^{-5}$ | $<1 \times 10^{-6}$ | $<3 \times 10^{8}$ | $<5 \times 10^{-9}$ | $<3 \times 10^{-10}$ |
| Line Voltage ± 10% | $<1 \times 10^{-8}$ | $<1 \times 10^{-9}$ | $<5 \times 10^{-10}$ | $<5 \times 10^{-10}$ | $<1 \times 10^{-11}$ |
| Warm-up Time to Reach $10^{-7}$ of Final Value | N/A | N/A | <15 min | <15 min | <6 min. to reach $10^{9}$ |

*after 48 hours of continuous operation

**after 1 month of continuous operation

## Ordering Information

### Model

**PM 6685/011** 300 MHz Frequency Counter *$1745*

**Included with Instrument**
One-year product warranty, line cord, operator manual, and Certificate of Calibration Practices.

### Input Frequency Options

**PM 6685/4--** 1.3 GHz Input C (PM 9621/001) *$595*
**PM 6685/6--** 2.7 GHz Input C (PM 9624/001) *$840*
**PM 6685/7--** 4.5 GHz Input C (PM 9625/001) *$3600*
**PM 6685/8--** 4.2 GHz Input C (PM 9625B/201) *$2500*

### Time Base Options

**PM 6685/-2-** TCXO (PM 9678/201) *$325*
**PM 6685/-4-** High Stability Oven Time Base (PM 9690/011) *$890*
**PM 6685/-5-** Very High Stability Oven Time Base (PM 9691/011) *$1095*
**PM 6685R/-7-** Rubidium Time Base* *$8900*
**PM 6685/-8-** Standard Time Base plus External Ref. Frequency Multiplier (1, 5 MHz) (PM 9697/001) *$250*

* Product physical dimensions are larger with rubidium time base. The rubidium time base is not customer installable. Call for complete product specifications and availability. (See special Rubidium Counters Section)

### Battery Unit and GPIB Interface Options

**PM 6685/--3** Battery Unit (PM 9623/001) *$450*
**PM 6685/--6** GPIB Interface (PM 9626/021) and Time & Frequency Analysis SW: TimeView *$100*
**PM 6685/--8** Battery Unit plus GPIB Interface and Time & Frequency Analysis SW: TimeView *$550*

### Example, Ordering Configuration

To order the 300MHz version with the TCXO Time Base and GPIB interface, select:

| | | Model<br>PM 6685 |
|---|---|---|
| Configuration<br>Option Suffix - | Input | /0-- |
| | Oscillator | /-2- |
| | Interface | /--6 |

Yields Complete Model Number PM 6685/026

### Options and Accessories

**PM 9621/001** 1.3 GHz Input C *$595*
**PM 9624/001** 2.7 GHz Input C *$840*
**PM 9625B/201** 4.2 GHz Input C *$2500*
**PM 9625/001** 4.5 GHz Input C *$3600*
**PM 9678/201** TCXO Time Base *$325*
**PM 9690/011** High Stability Oven Time Base *$890*
**PM 9691/011** Very High Stability Oven Time Base *$1095*
**PM 9697/001**** External Reference Multiplier (1, 5, 10 MHz) *$250*
**PM 9623/001***** Battery Unit *$450*
**PM 9626/021*** GPIB Interface *$650*
**PM 9622/001** Rack Mount Kit for PM 6685R *$170*
**PM 9622/021** Rack Mount Kit for PM6685 *$170*
**PM 9622/031** Side Handle Kit for PM6685 *$450*
**PM 9628/021** Cooling Fan (>50°C ambient) *$95*
**PM 9627/001** Carrying Case *$150*
**PM 8929/191** 500 MHz 10:1 probe 1MΩ/15pF *$175*
**PM 8911/091** 1.5 GHz 10:1 probe 50Ω for C channel option (BNC) *$240*

*PM 9626 GPIB-Interface includes Analog Output and TimeView Analysis software
**PM 9697 External Reference Multiplier can be used only with the Standard Time Base
***PM 9623 cannot be fitted in PM 6685R

When ordered together with the basic counter, options are factory installed. Options ordered separately can be customer retrofitted, except PM 9611/80 Rear Panel Inputs.

### Manuals

**PM 6685** Operator* P/N 948146 *$75*
**PM 6685** Programming* P/N 173484 *$100*
**PM 6685** Service P/N 949347 *$145*

*No charge with purchase of unit

### Customer Support Services

**Factory Warranty**
One-year product warranty.
Five-year warranty on Rubidium Element.

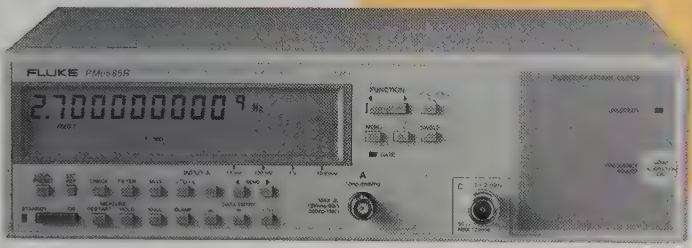
FLUKE

# Rubidium Counters

## PM 6685R Portable Frequency Counter/Calibrator
## PM 6681R Frequency Reference/Counter/Calibrator

Leading edge performance for field and cal lab

Outstanding accuracy and resolution, plus powerful TimeView™ analysis



PM 6685R

**New**

### Rubidium Timer/Counters

- High accuracy and short warm up times:
  $1 \times 10^{-9}$ within <6 min.
  $1 \times 10^{-10}$ within <30 min.
- Ageing $2 \times 10^{-10}$ per year
- Calibrates any application specific frequency
- 5 year warranty on Rubidium element
- 300 MHz range, optional to 4.5 GHz
- 10 MHz reference output (PM 6685R)
- 5 additional 10 MHz reference output (PM 6685R)

### PM 6685R Frequency Counter/Calibrator

- Connect-and-go convenience for test-bench and field use
- 10 digits per second measuring speed
- Smart AUTO trigger eliminates guess-work, provides error-free measurements
- Analog Bar Graph, Nulling, Digit blanking

### PM 6681R Frequency Reference/Counter/Calibrator

- Most powerful solution for Cal Lab
- Calibrates frequency, time intervals and phase
- 11 digits per second measuring speed
- 50 ps single-shot time interval resolution
- Down to 1 ps averaged time interval resolution
- 8k readings/s to internal memory with 50 ps resolution
- Repetitive sampling rate up to 10M/s
- High trigger level resolution 1.25 mV
- Very low systematic time error 500 ps
- High phase accuracy to 0.02°
- TimeView™ PC software including frequency-vs-time, FFT

### PM 6685R Portable Frequency Counter/Calibrator

### Today's Most Accurate Frequency Counter

The PM 6685R from Fluke is the most accurate frequency counter on the market. It offers all the functionality of the PM 6685, plus the stability and accuracy of a built-in Rubidium atomic reference.

High stability, high accuracy and short warm-up times make this instrument ideal for high-accuracy calibration procedures outside the cal lab environment, such as in base station transmitters of large tele-communication networks like GSM. The PM 6685R is already adopted for use by major telecom suppliers such as Ericsson, Motorola, Nokia, Alcatel and by GSM operators in most countries where GSM is in use.

The short warm-up time means that the PM 6685 Rubidium is ready for use within minutes after field transport or a change of location inside a building.

### High-Resolution Digital Frequency Counting

With a virtual clock frequency of 4 GHz, the PM 6685R offers an unmatched resolution of 250ps, giving up to 10 reliable read-out digits in just one second measuring time. This makes high-accuracy calibration measurements possible, with the convenience of requiring only a digital counter.

### Guaranteed High Stability for Field Operation

The built-in rubidium reference solves the practical problems of ensuring very high stability under tough field conditions. The atomic resonance principle of rubidium standards is intrinsically 100 times more stable than the electromechanical crystal resonator; a fact that contributes to making the PM 6685 Rubidium the most accurate counter/calibrator available for field use.

This performance makes PM 6685R an outstanding choice for field measurements and calibrations where accuracies better than a few parts in $10^8$ are required, or where frequent calibration of the counter is not possible.

### PM 6681R Frequency Reference/Counter/Calibrator

### Outstanding Accuracy and Resolution, Plus Powerful TimeView™ Analysis

The PM 6681R with Rubidium oscillator is a combined frequency reference source and a frequency-, phase- and timing counter/calibrator, having special source output(s)

Where the PM6685R is intended to offers Cal lab performance and portability for field applications, the PM6681R offers a complete solution for Cal Lab's and quality assurance stations.

### PM 6681: Breakthrough Timer/Counter/Analyzer Performance

With its revolutionary technology, the PM 6681 from Fluke sets the new standard for measurement of time intervals, frequency, phase and jitter. But PM 6681 is much more than just a timer/counter. Its speed and resolution are comparable to the most accurate time and frequency modulation domain analyzers. Connected to your PC running Fluke's TimeView software, PM 6681 fully matches the functionality of a dedicated modulation domain analyzer, at a fraction of the cost. An ultra-high 50 ps single-shot time resolution (20 GHz virtual clock frequency) allows it to reveal and characterize signal anomalies that would otherwise remain hidden-like noise or modulation artifacts.

With the Rubidium reference option built in, it is the most accurate Timer/Counter/Analyzer for the calibration of Frequency, Time intervals or Phase.

### Powerful Analysis Tools

For tough analysis problems, you can call on Fluke's TimeView PC software that handles time and frequency analysis and advanced statistical processing in the modulation domain. The analysis power of TimeView lets you quantify jitter and modulation, discover hidden jitter or frequency modulation sources, view frequency dynamics, plot agile frequency sources (frequency vs. time), analyze VCO transient responses, view frequency-locked-loop dynamics and much more. In addition, TimeView is an excellent tool to collect and print your data and generate protocols for documenting and archiving.

### High-Speed, High-Resolution Telecom Measurements

With the high resolution/speed performance of 11 digits/s this counter are ideal tools for frequency measurements in telecom systems. The PM 6681 timer/counter/analyzer span a frequency range of up to 4.5 GHz, which enables calibration of microwave links, satellite communications and radar equipment. You can make frequency measurements accurately and easily, not only on continuous carrier waves, but also on burst signals. This is due to the short measuring times, or our

GPIB
IEEE-488

# Rubidium Counters

## PM 6685R Portable Frequency Counter/Calibrator
## PM 6681R Frequency Reference/Counter/Calibrator

unique internal burst synchronization and arming functions that mask instability on the leading edge of the burst.

### Frequency Calibration

The Rubidium reference of the PM 6681R makes this instrument (together with the PM 6685 Rubidium) the most accurate Timer/Counter/Analyzer for frequency measurements.

### Time Calibration

For the calibration of time-intervals the PM 6681 provides leading performance due to the fast 50ps single shot time resolution (1ps average) and the high trigger level resolution of 1.25 mV. For monitoring purposes the analog output provides a DC voltage proportional to any three consecutive display digits. So it can be used for strip-chart recording or feedback to an analog control system.

### Phase Calibration

With PM 6681 you can measure phase differences on signals of up to 160 MHz with a resolution better than one-tenth of a degree (0.01° below 30 MHz). This gives you outstanding resolution in measurements like laser positioning and calibration of phase meters.

## Specifications

### Technical Specifications

(Where these differ from the standard models. Please refer to counter pages for full details.)

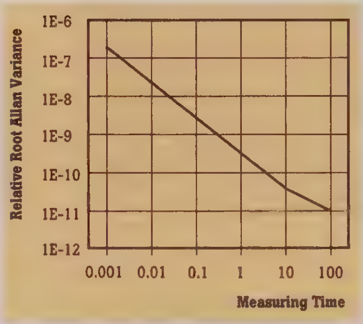
### Frequency Stability:

**Ageing**

Per month: $5 \times 10^{-11}$ (after 1 month of continuous operation)
Per year: $5 \times 10^{-10}$ (first year)
$2 \times 10^{-10}$ (after first year)

**Short-Term (Allan Var. of Ref. Osc.):**

1s: $1 \times 10^{-10}$
10s: $3 \times 10^{-11}$
100s: $1 \times 10^{-11}$



**Temperature Dependency:**
0 to 50°C : $3 \times 10^{-10}$
1-day stability at 25 ±3°C: $4 \times 10^{-11}$ after 7 days continuous operation
**Warm-up Time (at 25°C):** Unlocked status indicated by LED
**Time to Lock:** 4 minutes
**Time to Reach $1 \times 10^{-9}$:** 6 minutes
**Retrace:** $5 \times 10^{-11}$*

** Retrace is the relative frequency deviation after 1 hour operation, compared with the previous value, before a switch-off period of 24 hours.*

### Power Requirements (at 25°C)

**Voltage:** 90 to 264 Vrms, 47 to 440 Hz
**Power Rating:** <100W for <4 minutes, <50W continuous operation (at 25°C)

### Reference Outputs (PM 6681R)

5 additional 10 MHz reference outputs are available at the rear of the counter.
**Output Level:** >0.5 V RMS in 50 ohm load
**Wave Shape:** Sine wave

### Mechanical Data

| Weight | PM 6685R | PM 6681R |
|---|---|---|
| Net | 5.5 kg (12 lb) | 4.8 kg (10 lb) |
| Shipping | 8.8 kg (19 lb) | 7.8 kg (16.8 lb) |

## Ordering Information

### Basic Models

**PM 6681R/076** 300 MHz Frequency Reference/Counter/Calibrator including GPIB-interface and Time & Frequency Analysis Software, TimeView
**PM 6685R/071** 300 MHz Rubidium Frequency Counter/Calibrator ***$10,645***

### GPIB-Interface option (PM 6685R)

**PM 6685R /– – 6** GPIB-Interface (PM 9626/021*) and Time & Frequency Analysis Software, Timeview ***$100***

### Input Frequency Options

**PM 668 – R/4 – –** 1.3 GHz Input C (PM 9621/001) ***$595***
**PM 668 – R/6 – –** 2.7 GHz Input C (PM 9624/001) ***$840***
**PM 668 – R/7 – –** 4.5 GHz Input C (PM 9625/001) ***$3600***
**PM 668 – R/8 – –** 4.2 GHz Input C (PM 9625B/201) ***$2500***

### Example Ordering Configuration

To order the PM 6681R with the 2.7 GHz input C, select the complete Model Number: PM 6681/676.

### Options and Accessories

**PM 9621/001** 1.3 GHz Input C ***$595***
**PM 9624/001** 2.7 GHz Input C ***$840***
**PM 9625/001** 4.5 GHz Input C ***$3600***
**PM 9625B/201** 4.2 GHz Input C ***$2500***
**PM 9626/021*** GPIB-Interface for PM 6685R ***$650***
**PM 9622/001** Rack-Mount Kit ***$170***

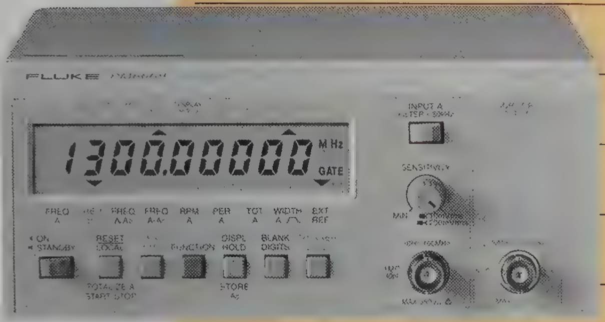
* PM 9626 GPIB-Interface includes Analog Output and TimeView Analysis software
When ordered together with the basic counter, options are factory installed.
Options ordered separately can be customer retrofitted, except PM 9611/80 Rear Panel Inputs (PM 6681R only). (Front inputs disconnected)

### Warranty

Five-year warranty on Rubidium Element.

## PM 6662 & PM 6669 Frequency Counters

- Unrivaled price/performance
- 160 MHz / 1.3 GHz option
- Reciprocal counting, 7 digits per second
- High stability MTCXO: 2x10$^{-7}$ over 0°C to 50°C with pushbutton calibration
- Error-free triggering, high noise immunity input circuitry
- Ease of operation, auto triggering, auto range and auto display
- Rugged, no compromise quality, MTBF 70.000h
- Excellent suppression of RF interference through all-metal cabinet
- Optional battery for field use



PM 6669

The PM 6662 and PM 6669 are economical, easy-to-use counters that meet demands for high-precision measurements, reliability and durability. The units use reciprocal frequency counting, which yields high resolution measuring results under all conditions, even on low frequency measurements.

The PM 6662 handles frequency measurements, while the multi-function PM 6669 also offers period, count totalization, ratios, pulsewidth and frequency difference measurements.

These counters have high input protection, allowing them to withstand inputs of 12V rms on the optional 50Ω RF input, and 350V (dc+ac peak) on the 1 MΩ LF input.

### The Versatile Counter - PM 6669

The PM 6669 offers as many as 8 measuring functions, including pulse width and relative frequency measurements, functions normally found only in more expensive timer/counters.

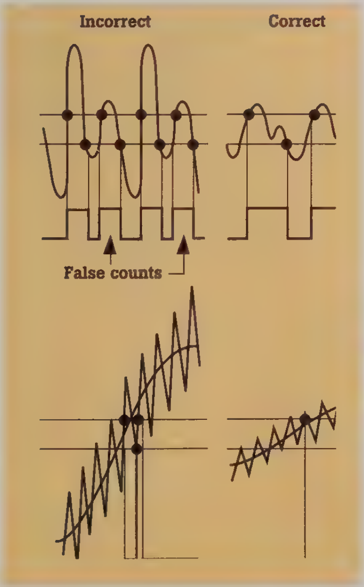
This counter can be used on the test bench, in GPIB/IEEE-488 systems, or for field service. It has a full 9-digit display, to allow complete presentation of measuring results. When less accurate measurements are made, blanking of irrelevant display digits makes it easy to read results.

### Smart and Simple - PM 6662

For frequency measurements, the PM 6662 combines the same high accuracy as the PM 6669 with simple, foolproof operation.

The AUTO DISPLAY function always gives the correct range (Hz, kHz or MHz) and resolution for any input frequency and selected measuring time.

AUTOTRIGGER automatically sets the right trigger level to ensure correct triggering, whatever the waveform. A choice of measuring times allows for the optimum selection of measuring speed versus accuracy. Selection of sensitivity over a wide range lets you suppress the influence of noise.



A variable input attenuator enables correct matching of the input signal to the trigger sensitivity of the counter. False counts caused by interference, distortion and noise are thereby prevented.

### MTCXO Time Base

MTCXO (Mathematically Temperature Compensated Crystal Oscillator). Counter stability and precision is ultimately determined by the time-base oscillator. This can be further improved with the optional high stability MTCXO time-base that offers a stability, comparable to that of an oven stabilized oscillator, but at much lower cost. The temperature dependency curve for each individual crystal oscillator is factory-measured, and the frequency deviations (Δf) across the temperature range are stored in a non-volatile memory.

During operation, the Δf value for the operating temperature is referenced in memory and used to compensate the measuring result before it is displayed. This automatic temperature compensation also results in highly accurate measurements instantly, without long warm-up times.

The unique MTCXO principle gives a residual temperature stability of 2 x 10$^{-7}$ over the temperature range 0°C to 50°C.

## Specifications

### Measuring Functions

#### Frequency A or B (optional)

**Frequency Range:** Freq A: 10 Hz to 160 MHz (120 MHz to 160 MHz with limited temperature range; typical +23°C ±5°C); Freq B: 70 MHz to 1.3 GHz (PM 9608B)

**Mode:** Reciprocal frequency measurement

**LSD Unit Displayed:**

$$\frac{2.5 \times 10^{-7} \times \text{FREQUENCY}}{\text{measuring time}}$$

#### Frequency A/A$_0$ (PM 6669 only)

FREQ A measurement is divided by the constant A$_0$ before display. A$_0$ is read in frequency mode using the STORE button. At power-on A$_0$ is set to 1 (default).

GPIB IEEE-488

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* The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

# PM 6662 & PM 6669 Frequency Counters

### Frequency Counter Selection Table

| | PM 6662 | PM 6669 |
|---|---|---|
| Freq. A | 10 Hz to 160 MHz | 10 Hz to 160 MHz |
| Freq. B option | 70 MHz to 1.3 GHz | 70 MHz to 1.3 GHz |
| Measuring Modes | Freq. A, Freq. B, | Freq. A, Freq. B, Period A, RPM A, Totalize A, Freq. $A/A_0$, Freq. $A-A_0$, Pulse width A |
| Other facilities | – | Display hold, Reset, Digit blanking |
| Measuring times | 0.2, 1 and 10s | 0.2, 1, 10s and SINGLE |
| Sensitivity A | 15 mV | 10 mV |
| Sensitivity B | 10 mV | 10 mV |
| Trigger level offset | 100% foolproof auto-trigger on any input duty factor | Manually set (+, 0, –) or auto-setting |
| Input A attenuator | x1 to x300, 6 steps | x1 to x400, cont. variable |
| Noise suppression filter | – | 50 kHz low pass |
| External Reference input | 10 MHz | 10 MHz |
| Options | MTCXO time base, 1.3 GHz HF input, Rack mount, Battery pack, Carrying case | MTCXO time base, 1.3 GHz HF input, GPIB interface, Rack mount, Battery pack, Carrying case |

### Frequency $A-A_0$ (PM 6669 only)

FREQ A measurement is subtracted by the constant $A_0$ before display. $A_0$ is read in frequency mode using the STORE button. At power-on $A_0$ is set to 0 (default).

### RPM A (PM 6669 only)

FREQ A measurement is multiplied by 60, and displayed as revolutions per minute (RPM).
**Range:** 6 RPM to 720 × $10^6$ RPM

### Period A (PM 6669 only)

**Range:** 8 ns to 2 × $10^8$s
**Mode:** Single period measurement (SINGLE) or period average measurement (at 0.2, 1 or 10s measuring times)
**LSD Displayed**
**SINGLE Period Measurement:**

$$100\text{ ns} \qquad (\text{TIME} < 100\text{s})$$

$$\frac{5 \times \text{PERIOD}}{10^9\text{s}} \qquad (\text{TIME} > 100\text{s})$$

**Period Average Measurement:**

$$\frac{2.5 \times 10^{-7} \times \text{PERIOD}}{\text{measuring time}}$$

### Totalize A (PM 6669 only)

Event counting is controlled by the START/STOP button. Sequential start-stop counts are accumulated.
**Range:** 0 to 1 × $10^{15}$ with indication of k or M (kilo-pulses or mega-pulses). The result is truncated to 9 digits.
**Frequency Range:** Sine wave: 10 Hz to 12 MHz; Pulse: 0 Hz to 12 MHz
**Pulse Pair Resolution:** 80 ns

### Width A (PM 6669 only)

A positive pulse width measurement is performed. Measuring time selection is not possible (always SINGLE)
**Range:** 100 ns to 2 × $10^8$ s
**LSD Displayed:**

$$100\text{ ns} \qquad (\text{TIME} < 100\text{ s})$$

$$\frac{5 \times \text{WIDTH}}{10^9\text{ s}} \qquad (\text{TIME} \geq 100\text{ s})$$

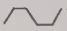
## Input Specifications

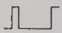
### Input A (PM 6662 only)

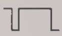
**Frequency Range:** 10 Hz to 160 MHz (120 MHz to 160 MHz with limited temperature range; typical +23°C ±5°C)
**Coupling:** AC
**Impedance:** 1 MΩ//30 pF
**Max Sensitivity:** Sine wave: 30 mV rms, 10 Hz to 100 Hz; 15 mV rms, 100 Hz to 75 MHz; 30 mV rms, 75 MHz to 120 MHz; 60 mV rms, typically: 120 MHz to 160 MHz (at room temperature). Pulse: 90 mV p-p, 10 Hz to 100 Hz; 45 mV p-p, 100 Hz to 75 MHz; 90 mV p-p, 75 MHz to 120 MHz.
**Minimum Pulse Duration:** 4 ns
**Attenuation:** x1, x3, x10, x30, x100 and x300. The attenuation selector is labelled sensitivity: 15 mV, 50 mV, 150 mV, 500 mV, 1.5V, 5V.
**Auto Trigger Level:** A fixed (+, 0 or –) trigger level offset is automatically applied to ensure correct triggering on any waveform and duty cycle.
**Maximum Voltage Without Damage:** 350V (dc + ac peak) dc to 440 Hz falling to 12V rms at 1 MHz

### Input A (PM 6669 only)

**Frequency Range:** 10 Hz to 160 MHz (120 MHz to 160 MHz with limited temperature range; typical +23°C ±5°C)
**Sensitivity:** Sine: 10 mV rms, 10 Hz to 120 MHz (30 mV rms typically, 120 MHz to 160 MHz at room temperature).
Pulse: 30 mV p-p 0 Hz to 120 MHz.
**Coupling:** AC
**Impedance:** 1 MΩ//30 pF
**Attenuation:** Continuously variable in two ranges between x1 and x400
**Filter:** Switchable 50 kHz low pass noise filter with a suppression of 20 dB at 200 kHz.
**Trigger Levels:** 3 different levels for triggering on signals with various duty factors, and AUTO:

 used for symmetrical input signals with a duty factor of 0.25 to 0.75;

 used for input signals with duty factor <0.25;

 used for input signals with duty factor >0.75.

**AUTO Trigger Level:** The counter selects a suitable trigger level setting automatically (not active in TOT-A measurements)
**Input Signal**
**Repetition Rate:** >100 Hz
**Trigger Slopes (GPIB/IEEE-488 only):** + or –
**Maximum Voltage Without Damage:** 350V (dc + ac peak) between dc and 440 Hz, falling to 11V rms at 1 MHz

### Input B (Option PM 9608B)

**Frequency Range:** 70 MHz to 1.3 GHz
**Coupling:** AC
**Operating Input Voltage Range:** 10 mV rms to 12V rms, 70 MHz to 900 MHz; 15 mV rms to 12V rms, 900 MHz to 1100 MHz; 40 mV rms to 12V rms, 1100 MHz to 1300 MHz
**AM Tolerance:** 94% at max 100 kHz modulation frequency. Minimum signal must exceed minimum operating input voltage requirement.
**Input Impedance:** 50Ω nominal, VSWR <2:1
**Max Voltage Without Damage:** 12V rms; overload protection with PIN diodes

### External Reference Input

The external reference input is automatically selected when an external signal of 9.9 MHz to 10.1 MHz is connected.
**Input Frequency:** 10 MHz ±0.1 MHz
**Coupling:** AC
**Operating Input Voltage Range:** 500 mV rms to 15V rms (sine)
**Maximum Voltage Without Damage:** 15V rms
**Impedance:** Approx 300Ω at 10 MHz

## Definitions

### LSD Displayed

LSD = Unit value of least significant digit displayed. All calculated LSDs should be rounded to the nearest decade (e.g. 0.3 Hz is rounded to 0.1 Hz and 5 Hz to 10 Hz) and cannot exceed the 9th digit.

### Resolution

Resolution = Smallest increment between two measuring results on the display, due to the 1 count error
**Freq A, B, Period A:** Resolution can be 1 LSD unit or 2 LSD units.

$$\text{If: } \frac{\text{LSD} \times \text{Measuring time}}{\text{FREQ or PERIOD}} < 10^{-7}$$

the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability).
**SINGLE Period A and Width A:** Resolution = 1 LSD unit.

### Inaccuracy

Inaccuracy, i.e., the relative error, depends on the following factors:

$$\pm \frac{\text{Resolution}}{\text{FREQ, PERIOD or WIDTH}}$$

± relative trigger error
± relative time base error

## PM 6662 & PM 6669 Frequency Counters

### Relative Trigger Error

**Frequency A, Period A:**

$$\pm \frac{\text{noise voltage A (Vp-p)}}{\text{signal slope A (V/s)} \times \text{meas. time(s)}}$$

### Relative Time Base Error:

$$\pm \frac{\text{deviation from 10 MHz}}{\text{10 MHz}}$$

Note: For WIDTH measurements, triggering on 50% of amplitude will occur only if the signal duty factor is 0.5. In other cases the timing error caused by wrong trigger level setting should be added to inaccuracy.

## General Specifications

### Power Requirements

**Line Voltage:** 115V or 230V ±15%, 45 Hz to 440 Hz, less than 20 VA
**Fuse:** Internal thermal fuse in line transformer
**Line Interference:** Below VDE 0871B

### Time-Base

**Alternatives:** Standard built-in crystal oscillator. Order no. PM6662/.1. or PM 6669/.1. MTCXO, Order no. PM 6662/.3. or PM 6669/.3. The MTCXO can be separately ordered (option PM 9607) for later upgrading of the counter.

| Osc. Version | Standard | MTCXO |
|---|---|---|
| Stability against: | | |
| Aging/month | $<5 \times 10^{-7}$ | $<1 \times 10^{-7}$ |
| /year | $<5 \times 10^{-6}$ | $<5 \times 10^{-7}$ |
| Temperature 0°C to 50°C | $<1 \times 10^{-5}$ | $<2 \times 10^{-7}$ |
| Line voltage change 10% | $<1 \times 10^{-8}$ | $<1 \times 10^{-9}$ |
| Change in supply line/battery | $<5 \times 10^{-7}$ | $<1 \times 10^{-8}$ |

### Display

**Readout:** 9-digit LCD with unit indication
**Gate Indicator:** Indicates gate open, i.e. measurement activity

### Cursors

**PM 6662:** Indicate used input (A or B), measuring time and use of ext. reference frequency
**PM 6669:** Indicate selected measuring function, measuring time, input triggering, display hold and use of ext. reference frequency

### Measuring Time/Rate

**PM 6662:** 0.2, 1 and 10s
**PM 6669:** 0.2, 1, 10s and SINGLE
*Note: SINGLE selected in PERIOD or WIDTH, results in a single cycle measurement. SINGLE in FREQUENCY or RPM, results in a fixed measuring time of 3 ms*
**Display Time:** The display time equals measuring time plus approx 100 ms
**Maximum Measuring Rate:** Approximately 5 measurements/s (standard oscillator) or 2 measurements/s (MTCXO)

### Environmental Data

**Warm-up Time to Reach Specification:** 5 min.

### Temperature

**Storage:** −40°C to +70°C
**Operating:** 0°C to +50°C
**Altitude:** Operating and non-operating; 4600m (15000 ft)
**Humidity:** 95% R.H.; 0°C to 40°C
**Vibration:** Operating; 15 min along each of the 3 major axis, 10 Hz to 150 Hz, 0.3 mm p-p displacement and 2g max acceleration
**Shock:** (Operating) 3 shocks along each of the 3 major axis, half sine wave, 6 ms duration and 40g acceleration pulses
**Bench Handling:** MIL-STD-810D method 516.3, procedure VI
**EMC:** Meets VDE 0871(B) and FCC part 15J, CE
**Safety:** CSA Bulletin 556B certified and Philips certification to comply with IEC 348 Class I, CE

### Mechanical Data

**Size**
**PM 6662:** 186 mm W × 88 mm H × 220 mm L (7.3 in W × 3.5 in H × 8.7 in L)
**PM 6669:** 186 mm W × 88 mm H × 270 mm L (7.3 in W × 3.5 in H × 10.7 in L)
**Net Weight**
**PM 6662:** 1.6 kg (3.6 lb)
**PM 6669:** 2.1 kg (4.6 lb)
**Shipping Weight**
**PM 6662:** 2.6 kg (5.7 lb)
**PM 6669:** 3.1 kg (6.8 lb)
**Cabinet:** All-metal cabinet with a fold-down tilting support that also acts as a handle

## Optional Accessories

### GPIB Interface, PM 9604 (PM 6669 only)

**Mounting:** Inside counter cabinet
**Interface Functions:** SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E2
**Address Setting:** Switch selectable between 0 and 30
**Programmable Device Functions:** All front panel settings except Power on/Standby, sensitivity and filter on/off; plus Trigger Slope (pos/neg)

### High-Speed Dump

The contents of internal registers are transferred to the controller, without being processed by the counter. The processing may be done in the controller instead.
**Max Output Rate:** Approx 100 readings/s

### Maximum Data Output Rate

**Normal Mode:** Approx 5 readings/s
**High-Speed Dump:** Approx 100 readings/s
**Output Time for Measuring Data**
**Normal Mode:** Approx 15 ms (20 bytes)
**High Speed Mode:** Approx 6 ms (15 bytes)
**Response Time for Addressing:** Approx 600 μs
**Response Time for Trigger Command (GET):** Approx 10 ms
**Typical Read Time for Programming Data:** Approx 1 ms/byte

### Battery Unit PM 9605

The PM 9605 is a rechargeable battery unit for mounting inside the counter. The unit contains a standard 6V sealed lead-acid battery and an automatic battery charger.
**Battery Capacity (20°C):** Approx 15 Wh
**Operating Time When Battery Powered:** Approx 3 hours of continuous operation
**Recharging Time:** 7 hours to approx 75% of full capacity
**Battery Protection:** Overcharge protection and deep discharge (auto-shut-off) protection
**Low Battery Indication:** All display indications will blink when approx 15 minutes operation time is left

### Temperature

**Operating:** 0°C to +40°C
**Storage:** −40°C to +50°C
**Weight:** 0.8 kg
**Carrying Case, PM 9609**
The PM 9609 is a simulated leather case to protect the PM 6662/69 counter during transportation.

# PM 6662 & PM 6669 Frequency Counters

## Ordering Information

### Models
**PM 6662** Frequency Counter ***$780***
**PM 6669** Frequency Counter ***$1020***

### Included with Instrument
One-year product warranty, line cord, operator manual, and Certificate of Calibration Practices.

### Optional Configurations
When ordering, select either PM 6662 or PM 6669 mainframe, plus construct a 3-digit/suffix by selecting 1-digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface.

### Input Frequency Option
**/0--** Standard 160 MHz ***$NC***
**/4--** 1.3 GHz (PM 9608/201) ***$430***

### Reference Oscillator Option
**/-1-** Standard ***$NC***
**/-3-** MTCXO (PM 9607/001) ***$340***

### Interface Option (Battery)
**/--1** Standard line voltage, non GPIB/IEEE-488 ***$NC***
**/--3** Battery (PM 9605/001) ***$375***
**/--6** GPIB/IEEE-488 (PM 9604/001) (for PM 6669) ***$310***

### Example, Ordering Configuration
To order the PM 6669 with standard 160 MHz input, MTCXO Oscillator, and no interface, select:

| | |
|---|---|
| | **Model** |
| Configuration | **PM 6669** |
| Option Suffix - Input | /0-- |
| Oscillator | /-3- |
| Interface | /--1 |
| Yields Complete Model Number | **PM 6669/031** |

### Options & Accessories
**PM 9581/011** 50Ω Termination, 3W ***$100***
**PM 9585/011** 50Ω Termination, 1W ***$60***
**PM 9604/001** GPIB Interface (for PM 6669) ***$310***
**PM 9605/001** Battery Unit ***$375***
**HM 9606/03** Rack kit for PM 6662/6669 and 8840/2 or PM 2534/35 DMM ***$185***
**PM 9606/011** Rack kit for PM 6662/6669 ***$200***
**PM 9606/021** Rack kit for 2 counters ***$265***
**PM 9607/001** MTCXO Time Base ***$340***
**PM 9608/201** 1.3 GHz HF-Input ***$430***
**PM 9609/001** Carrying Case ***$100***

*All options can be field installed by the user. Note: Options PM 9604 and PM 9605 cannot be installed together in a PM 6669 Counter.*

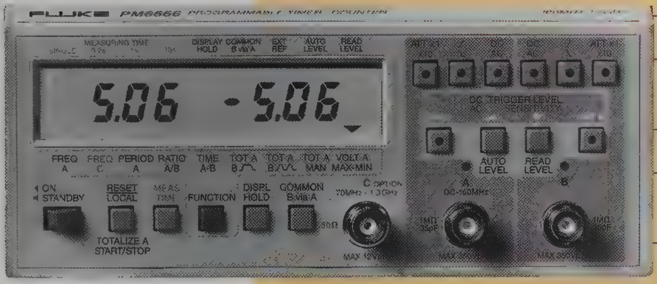
### Manuals
**PM 6662** Operator* P/N 949230 ***$12***
**PM 6669** Operator* P/N 949706 ***$25***
**PM 6669** Service P/N 948237 ***$115***
**No charge with purchase of unit*

## Customer Support Services

### Factory Warranty
One-year product warranty.

# Counters & Timer/Counters

## PM 6665 & PM 6666 Programmable Timer/Counters



PM 6666

- Unrivaled price/performance
- 160 MHz / 1.3 GHz option
- High resolution reciprocal counting
- High stability MTCXO: 2x10⁻⁷ over 0°C to 50°C with pushbutton calibration
- High trigger accuracy
- PM 6666: Full GPIB/IEEE-488 programmability, Auto trigger, Voltage Measurements
- PM 6665: Continuous variable sensitivity, HF filter
- Rugged, no compromise quality, MTBF 50.000h
- Excellent suppression of RF interference through all-metal cabinet
- Field use, battery operation

### Introduction

The PM 6665 and PM 6666 are very versatile timer/counters with many functions included as standard.

The units use the reciprocal frequency counting technique, which yields high resolution measuring results under all conditions, even on low frequency measurements.

Measuring accuracy is increased by the high performance counter front-ends, providing variable sensitivity and noise immunity. Accuracy can be further improved with the optional high stability MTCXO time-base that offers a stability of $2 \times 10^{-7}$ (0°C to 50°C), comparable with that of an oven stabilized oscillator. See PM 6662/69 counters for detailed information.

All major functions can be programmed via GPIB interface with the PM 6665; and the PM 6666 offers 100% programmability including trigger level and sensitivity settings.

### PM 6666 Programmable Timer/Counter

The PM 6666 is a low cost timer/counter with high accuracy frequency, time and voltage measurements that also offers 100% programmable GPIB/IEEE-488 operation. All measurement functions including trigger level settings and sensitivity can be programmed. A bus learn mode is provided to speed and simplify programming. The PM 6666 is also an excellent all-purpose instrument for bench-top use, with 9 front panel selectable measuring functions including voltage max./min. measurements.

### Error-Free Triggering

Triggering is error-free on the PM 6666 for all waveforms. Trigger-level setting can be automatic on all input signals over 100 Hz. Resolution is 20/200 mV, over a very wide range (-50V to +50V) that allows measurements to be accurate even on high voltage events. The trigger level can be displayed immediately with one keystroke; and inputs can be instantly checked for triggering with the tri-state LED trigger indicators.

To give the various noise immunity settings, input sensitivity has six steps, from 20 mV to 1V rms.

### Peak Voltage Measurements to 50 MHz

The PM 6666 has Volt peak measurements up to 50 MHz. When displaying Vmax./min. measurements, positive and negative signal peaks of the input signal are shown simultaneously with a resolution of 20 or 200 mV.

### High Resolution

Both the PM 6665 and PM 6666 can measure low frequency signals to high resolution with synchronized multiple period measurements and computing the reciprocal values.

Resolution is at least 7 digits on a 1s measuring time, because the traditional ±1 input cycle error is eliminated. Time interval measurements are high resolution as well as high accuracy, due to the time interval averaging technique. The 100 ns resolution is improved by a factor $\sqrt{N}$ ($N$ = number of time intervals averaged) when compared with single time interval measurements.

### PM 6665 Universal Timer/Counter

The PM 6665 timer/counter is specifically designed for applications with a small budget but a demand for a broad range of high performance counting and timing.

It is a compact timer/counter for bench-top, field and small system applications.

### Optimal Time Measurements

The inputs for time measurements in the PM 6665 incorporate high speed synchronizers and equalized input channels to eliminate differences in delay and rise-time. High sensitivity inputs reduce the possibility of trigger errors; trigger levels can be selected in the range from -50V to +50V and trigger indicators simplify level setting.

### Frequency Measurements

Frequency measurements must have a variable noise immunity, which in practice means variable sensitivity for correct triggering. On the PM 6665 this is accomplished with the continuously variable x1 to x100 input signal attenuator.

### Noise Rejection Filter Standard

The built-in noise rejection filter is useful for cleaning up noisy LF signals and for filtering off HF noise, even at levels higher than the input signal.

## Specifications

### Frequency A or C

(frequency B via GPIB/IEEE-488 only)

**Range**

**Freq A:** 0.1 Hz to 160 MHz (120 MHz to 160 MHz with limited temperature range; typical +23°C ±5°C)

**Freq B:** 0.1 Hz to 16 MHz (via GPIB/IEEE-488 only)

**XFreq C:** 70 MHz to 1.3 GHz (optional)

**Mode:** Reciprocal frequency counting

**LSD Displayed:** $\frac{2.5 \times 10^{-7} \times \text{FREQ}}{\text{measuring time}}$

### RPM A (PM 6665 only)

The FREQUENCY A measurement is taken, multiplied by 60 and shown on the display as revolutions per minute (rpm)

**Range:** 6 rpm to $720 \times 10^{6}$ rpm

### Period A

**Range:** 8 ns to $2 \times 10^{8}$s

**Mode:** Single period measurement

GPIB
IEEE-488

## PM 6665 & PM 6666 Programmable Timer/Counters

### Timer/Counters Selection Table

| | PM 6665 | PM 6666 |
|---|---|---|
| Freq. A | 0.1 Hz to 160 MHz | 0.1 Hz to 160 MHz |
| Freq. B via GPIB | 0.1 Hz to 16 MHz | 0.1 Hz to 16 MHz |
| Freq. C option | 70 MHz to 1.3 GHz | 70 MHz to 1.3 GHz |
| Measuring Modes | Freq. A, Freq. B, Freq. C Period A, RPM A, Ratio A/B, Totalize A, Time Interval A-B | Freq. A, Freq. B, Freq. C Period A, Ratio A/B Ratio B/A, C/A, C/B via GPIB Totalize A, Time Interval A-B Volt max./min. A |
| Measuring times | 0.2, 1 and 10s and SINGLE | 0.2, 1, 10s and SINGLE |
| Sensitivity setting | Continue variable | 6 steps |
| Sensitivity range | x1 ... x100 | x1 ... x50 |
| Trigger level | Manual continue | AUTO, Manual, GPIB |
| Input attenuator | x1 to x10 | x1 x10 AUTO |
| Noise suppression filter | 50 kHz | Option |
| Digit blanking | yes | - |
| GPIB programmable | partial | full |
| External Reference input | 10 MHz | 10 MHz |
| Options | MTCXO time base, 1.3 GHz RF input, GPIB interface, Rack mount, Battery pack, Carrying case | MTCXO time base, 1.3 GHz RF input, GPIB interface, Rack mount, Battery pack, Carrying case |

(SINGLE) or average period measurement (at 0.2s, 1s or 10s measuring times)
**LSD Displayed:** SINGLE period measurement: 100 ns (TIME <100s); average period measurement:

$$\frac{2.5 \times 10^{-7} \times \text{PERIOD}}{\text{measuring time}}$$

### Ratio A/B

(ratio B/A, C/A or C/B via GPIB/IEEE-488 only)
**Range:** $1 \times 10^{-7}$ to $2 \times 10^{9}$ (A/B); $1 \times 10^{-8}$ to $2 \times 10^{8}$ (B/A); 0 to $1 \times 10^{15}$ (A/B SINGLE and B/A SINGLE); 8 to $6 \times 10^{10}$ (C/A, C/B)
**Frequency Range**
**Input A:** 0 MHz to 160 MHz (A/B); 0 MHz to 16 MHz (B/A, C/A, A/B SINGLE) (120 MHz to 160 MHz with limited temperature range; typical +23°C ±5°C)
**Input B:** 0 MHz to 16 MHz
**Input C:** 70 MHz to 1.3 GHz

### Time Interval A/B

(time interval B-A via GPIB/IEEE-488 only)
**Range:** 100 ns to $2 \times 10^{8}$s (SINGLE); 0 ns to 20s (average)
**Mode:** Single time interval (SINGLE) for time interval measurements (at 0.2s, 1s or 10s measuring times)
**LSD Displayed:** SINGLE time interval measurement: 100 ns (TIME <100s); Average time interval measurements:

$$\frac{2.5 \times 10^{-7}\text{s}}{N}$$

**Averaged Number of Intervals N:**

$$\frac{\text{measuring time}}{\text{pulse repetition time}}$$

*Note: Input signals must be repetitive and asynchronous with respect to the time base.*
**Min Dead Time from Stop to Start:** 250 ns
**Timing Difference A-B Channels:** 4 ns max

### Totalize A

(totalize B via GPIB/IEEE-488 only)
**Range:** 0 to $1 \times 10^{15}$ with indication of k or M (kilopulses or Megapulses) the result is truncated if out of display range
**Frequency Range:** 0 Hz to 12 MHz
**Pulse Pair Resolution:** 80 ns
**LSD Displayed:** 1 unit count (counts $<10^{9}$); 5x counts/$10^{9}$ (counts $\geq 10^{9}$)
**Gated by B (A) Mode:** Event counting on input A (B) during the duration of a pulse on input B (A)
**Start/Stop by B (A) Mode:** Event counting on input A (B) between two consecutive pulses on input B (A)
**Manual Mode:** Event counting is controlled by the START/STOP button. Sequential start-stop counts are accumulated. RESET closes the gate and resets the timer/counter to zero.
**Volt Max/Min A** (PM 6666 only; volt max/min B via GPIB/IEEE-488 only)
**Range:** −51V to +51V
**Frequency Range:** DC and 100 Hz to 50 MHz (input A); dc and 100 Hz to 5 MHz (input B)
**Resolution:** Input signals within ±5V, 20 mV; input signals outside ±5V, 200 mV
**Inaccuracy DC and 100 Hz to 12 MHz (A), or to 1 MHz (B):** Input signals within ±5V, 30 mV ±1% of reading ±3% of V p-p; input signals outside ±5V, 300 mV ±3% of reading ±3% of V p-p
**Inaccuracy 12 MHz to 50 MHz (A) or 1 MHz to 5 MHz (B):** Input signals within ±5V, 30 mV ±10% of reading ±10% of V p-p; input signals outside ±5V, 300 mV ±10% of reading ±10% of V p-p

### Input-A and Input-B

(PM 6665 only)

### Frequency Range

**DC-Coupled:** DC to 160 MHz (120 MHz to 160 MHz with limited temperature range; typical +23°C ±5°C)
**AC-Coupled:** 20 Hz to 160 MHz (120 MHz to 160 MHz with limited temperature range; typical +23°C ±5°C)
**Minimum Pulse Duration:** 4 ns
**Coupling:** AC- or dc-coupled, switch selectable
**Impedance:** 1 MΩ//35 pF
**Channel Input:** Separate A and B, or common via A
**Maximum Voltage Without Damage:** 350V (dc + ac peak) between 0 Hz and 440 Hz, falling to 8V rms at 1 MHz.

### Sensitivity, DC-Coupled

**Sine:** 20 mV rms, 0 Hz to 100 MHz; 30 mV rms, 100 MHz to 120 MHz
**Pulse:** 60 mV p-p, 0 Hz to 100 MHz; 90 mV p-p, 100 MHz to 120 MHz; sensitivity decreases to 60 mV rms at 160 MHz typically

### Sensitivity, AC-Coupled

**Sine:** 20 mV rms to 200 mV rms, 20 Hz to 100 MHz; 30 mV rms to 300 mV rms, 100 MHz to 120 MHz, continuously variable; sensitivity decreases to 60 mV rms typ. 120 MHz to 160 MHz at room temperature
**Filter:** Switchable 50 kHz low pass noise filter with approx 40 dB suppression at 1 MHz
**Attenuation:** x1 or x10
**Trigger Slopes:** Positive or negative, switch selectable

### Trigger Level Range

**DC-Coupled:** +5V to −5V (attenuator x1); −50V to +50V (attenuator x10); adjustable by potentiometer
**AC-Coupled:** 0V fixed
**Trigger Indicators:** Indication on LCD display when triggering on inputs A or B occurs

### Input-A and Input-B (PM 6666 only)

### Frequency Range

**DC-Coupled:** DC to 160 MHz (120 MHz to 160 MHz with limited temperature range; typical +23°C ±5°C)
**AC-Coupled:** 20 Hz to 160 MHz (120 MHz to 160 MHz with limited temperature range; typical +23°C ±5°C)
**Minimum Pulse Duration:** 4 ns
**Coupling:** AC or dc
**Impedance:** 1 MΩ//35 pF
**Channel Input:** Separate A and B, or common via A
**Maximum Voltage Without Damage:** 350V (dc + ac peak) between 0 Hz and 440 Hz, falling to 8V rms at 1 MHz

### Sensitivity, DC-Coupled

**Sine:** 20 mV rms, 0 Hz to 30 MHz; 40 mV rms, 30 MHz to 120 MHz, 60 mV rms typ., 120 MHz to 160 MHz (at room temperature)

# PM 6665 & PM 6666 Programmable Timer/Counters

**Pulse:** 60 mV p-p, 0 Hz to 30 MHz; 110 mV p-p, 30 Hz to 120 MHz; sensitivity decreases to 60 mV rms at 160 MHz typically

### Sensitivity, AC-Coupled

Sensitivity is selectable in 6 steps: 20 mV, 50 mV, 100 mV, 200 mV, 500 mV and 1V rms (sine) nominal
**Maximum Sensitivity:** 20 mV rms, 20 Hz to 30 MHz; 40 mV rms, 30 MHz to 120 MHz; sensitivity decreases to 60 mV rms typ., 120 MHz to 160 MHz (at room temperature)
**Attenuation:** x1 or x10, switch selectable or AUTO
**Trigger Slopes:** Positive or negative

### Trigger Level Range

**DC-Coupled:** −51V to +51V, adjustable via up/ down control
**AC-Coupled:** 0V fixed or AUTO level
**Trigger Level Resolution:** 20 mV, signals within ±5V; 200 mV, signals outside ±5V
**Trigger Level Setting Accuracy:** ±10 mV ±1% of setting
**AUTO Trigger Level:** Trigger Level on input A (and B when required) is automatically set to 50% of input signal amplitude.
**Frequency Range:** 100 Hz to 160 MHz (120 MHz to 160 MHz with limited temperature range; typical +23°C ±5°C)
**Trigger Indicators:** Tri-state LED indicators

### Input C (Option PM 9608B)

**Frequency Range:** 70 MHz to 1.3 GHz
**Coupling:** AC
**Operating Input Voltage Range:** 10 mV rms to 12V rms, 70 MHz to 900 MHz; 15 mV rms to 12V rms, 900 MHz to 1100 MHz; 40 mV rms to 12V rms, 1100 MHz to 1300 MHz
**AM Tolerance:** 94% at max 100 kHz modulation frequency; minimum signal must exceed minimum operating input voltage requirement
**Input Impedance:** 50Ω nominal, VSWR <2:1
**Max Voltage Without Damage:** 12V rms, overload protection with pin diodes

### External Reference Input D

**Input Frequency:** 10 MHz ±0.1 MHz
**Coupling:** AC
**Sensitivity:** 500 mV rms
**Input Impedance:** Approx 300Ω at 10 MHz
**Maximum Input Voltage:** 15V rms

## Auxiliary Functions

### RESET

The RESET button has three functions:
**RESET:** Starts a new measurement. The settings are not changed.
**LOCAL:** Makes the counter go to LOCAL operation, when in remote operation (unless Local Lock-Out is programmed).
**START/STOP:** Opens/closes the gate in TOTALIZE A, manual mode.

### Measuring Time

A measuring time of 0.2s, 1s, 10s or SINGLE can be selected

### Display Hold

The current measuring result is frozen on the display. A new measurement starts when the RESET button is pressed.

## Definitions

### LSD Displayed

LSD = unit value of the least significant digit displayed. All calculated LSDs (see Measuring Functions section) should be rounded to the nearest decade (e.g., 0.3 Hz is rounded to 0.1 Hz and 5 Hz to 10 Hz) and cannot exceed the 9th digit.

### Resolution

Resolution = smallest increment between two measuring results on the display, due to the ±1 count error.
**Freq A, Freq C, Period A:** Resolution can be 1 LSD or 2 LSD if:

$$\frac{\text{LSD} \times \text{measuring time}}{\text{FREQ or PERIOD}} < 10^{-7}$$

the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability).
**Ratio A/B:** Resolution can be 1 LSD or 2 LSD. If:

$$\frac{\text{LSD} \times \text{measuring time}}{\text{RATIO}} < \frac{10}{\text{FREQ A}}$$

the resolution is 2 LSD units (30% probability). Otherwise resolution is 1 LSD unit (70% probability).
**SINGLE Period A and SINGLE Ratio A/B:** Resolution equals 1 LSD unit
**Time A-B:** Resolution (95% confidence level) equals 1 LSD unit or 100 ns/N, whichever is greater

### Inaccuracy

Inaccuracy, i.e., the relative error, depends on the following factors:
Resolution

$$\pm \frac{}{\text{FREQ, PERIOD RATIO or TIME}}$$

relative trigger error
± relative time base error
± relative systematic error

### Relative Trigger Error

**Freq A, Period A:**

$$\pm \frac{\text{noise voltage A (V p-p)}}{\text{signal slope A (V/s)} \times \text{meas time}}$$

**Ratio A/B:**

$$\pm \frac{\text{noise voltage B (V p-p)}}{\text{signal slope B (V/s)} \times \text{meas. time}}$$

**Totalize A, Gated or Start/Stop by B:**

$$\pm \frac{\text{noise voltage B (V p-p)}}{\text{signal slope B (V/s)} \times \text{gate time B}}$$

**Time A-B:**

$$\pm \frac{\text{noise voltage A (V p-p)}}{\text{signal slope A (V/s)} \times \text{TIME} \times \text{N}}$$

$$\pm \frac{\text{noise voltage B (V p-p)}}{\text{signal slope B (V/s)} \times \text{TIME} \times \text{N}}$$

**Relative Time Base Error:**

$$\pm \frac{\text{deviation from 10 MHz}}{\text{10 MHz}}$$

**Relative Time A-B Systematic Error:** Inaccuracy caused by timing difference between A and B channels <±4 ns/TIME

## General Specifications

### Power Requirements

**Line Voltage:** 115V or 230V rms ±15%; 46 Hz to 440 Hz; <22 VA (PM 6665); resp <24 VA (PM 6666) including all options
**Safety:** In accordance with IEC 348 Class I and CSA 556B, CE
**Line Interference:** Below VDE 0871 B and MIL STD 461, CE
**Battery Unit:** See PM 9605 option

| **Oscillator Version** | **Standard** | **MTCXO** |
|---|---|---|
| **Stability Against** | | |
| Aging<br>Per Month<br>Per Year | <br>$<5 \times 10^{-7}$<br>$<5 \times 10^{-6}$ | <br>$<1 \times 10^{-7}$<br>$<5 \times 10^{-7}$ |
| Temperature Changes 0°C to 50°C | $<1 \times 10^{-5}$ | $<2 \times 10^{-7}$ |
| Line Voltage Changes 10% | $<1 \times 10^{-8}$ | $<1 \times 10^{-9}$ |

### Display

**Readout:** 9-digit LCD with unit and cursor indication
**GATE Indicator:** Indicates that the counter is measuring
**REMOTE Indicator:** Indicates when the counter is remotely controlled via an installed GPIB/IEEE-488 interface (PM 9604)

### Environmental Data

**Temperature**
**Operating:** 0°C to +50°
**Storage:** −40°C to +70°
**Altitude**
**Operating:** 5000m (53.3 kN/m²)
**Storage:** 15,000m (15.2 kN/m²)
**Humidity**
**Operating:** 10% to 90% RH, no condensation
**Storage:** 5% to 95% RH

### Mechanical Data

**Size:** 186 mm W × 88 mm H × 270 mm L (7.3 in W × 3.5 in H × 10.6 in L)
**Weight:** 2.1 kg (4.6 lb)

## Optional Accessories

### GPIB/IEEE-488 Interface, PM 9604

**Mounting:** Inside counter cabinet
**Interface Functions:** SH1, AH1, T5, L4, SR1, RL1, DC1, DT1, E2

### Max Data Output Rate

**Normal Mode:** Approx 5 readings/s
**High-Speed Dump:** Approx 100 readings/s. The highest output rate is obtained

at SINGLE measuring time.
**High-Speed Dump:** The contents of the counting registers are transferred to the controller, without being processed by the counter. The processing must be done in the controller instead.

### Output Time for Measuring Data

**Normal Mode:** Approx 9 ms (20 bytes)
**High-Speed Mode:** Approx 4 ms (15 bytes)
**Response Time for Addressing:** Approx 600 µs
**Response Time for Trigger Command (GET):** Approx 10 ms
**Typical Read Time for Programming Data:** Approx 1 ms/byte

### Battery Unit PM 9605

The PM 9605 is a rechargeable battery unit for mounting inside the counter. The unit contains a standard 6V sealed lead-acid battery and an automatic battery charger.
**Battery Capacity (20°C):** Approx 15 Wh
**Operating Time When Battery Powered:** Approx 2 hours (PM 6666) or 2.5 hours (PM 6665) of continuous operation
**Recharging Time:** 5 hours to approx 75% of full capacity
**Battery Protection:** Overcharge protection and deep discharge (auto shut-off) protection

### Temperature

**Operating:** 0°C to +40°C
**Storage:** −40°C to +50°C
**Weight:** 0.8 kg (1.8 lb)

### Carrying Case PM 9609

The PM 9609 is a leather-like carrying case, for protection of the counter during transportation.

## Ordering Information

### Models

**PM 6665** Timer/Counter ***$1120***
**PM 6666** Timer/Counter ***$1220***

### Included with the Instrument

One-year product warranty, line cord, operator manual, and Certificate of Calibration Practices.

### Optional Configurations

When ordering, select basic "PM" Model desired from above, plus construct a 3-digit/suffix by selecting 1-digit in each suffix column to identify Input Frequency, Reference Oscillator, and Interface.

### Input Frequency Option

**/0--** Standard 160 MHz
**/4--** 1.3 GHz (PM 9608B/00) ***$430***

### Reference Oscillator Option

**/-1-** Standard
**/-3-** MTCXO (PM 9607/00) ***$340***

### Interface Option

**/--1** Standard line voltage, non GPIB/IEEE-488
**/--3** Battery (PM 9605/00) ***$375***
**/--6** GPIB/IEEE-488 (PM 9604/00) ***$310***

### Example, Ordering Configurating

To order the PM 6666 with standard 160 MHz input, MTCXO Oscillator, and standard interface, select:

| | | |
|---|---|---|
| Configuration | | PM 6666 |
| Option Suffix - Input | | /0-- |
| | Oscillator | /-3- |
| | Interface | /--1 |
| Yields Complete Model Number | | PM 6666/031 |

### Options and Accessories

**PM 9581/011** 50Ω Termination 3W ***$100***
**PM 9585/011** 50Ω Termination 1W ***$60***
**PM 9604/001** * GPIB Interface ***$310***
**PM 9605/001** * Battery Unit ***$375***
**HM 9606/00** Rack Kit for PM 6665/66 and 8840A/42A, PM 2525/34/35 DMMs ***$185***
**PM 9606/011** Rack Kit for PM 6665/66 ***$200***
**PM 9606/021** Rack Kit for 2 Counters ***$265***
**PM 9607/001** MTCXO Time Base ***$340***
**PM 9608/201** 1.3 GHz HF-Input ***$430***
**PM 9609/001** Carrying Case ***$100***

All options can be field installed by the user.
*The GPIB interface PM 9604 and the battery unit PM 9605 cannot be installed together in a PM 6665/66 counter.

### Manuals

**PM 6665** Operator*
**PM 6666** Operator*
**PM 6665/66/69** Pocket Guide
**PM 6665/66** Service
*No charge with purchase of unit

## Customer Support Services

### Factory Warranty

One-year product warranty.

# Software

## TimeView™ PC software

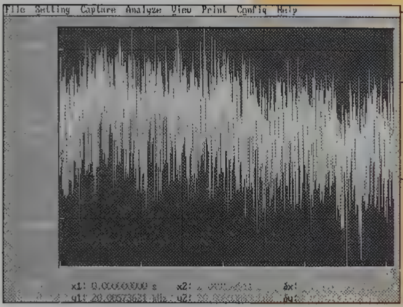
View dynamic frequency variations over time

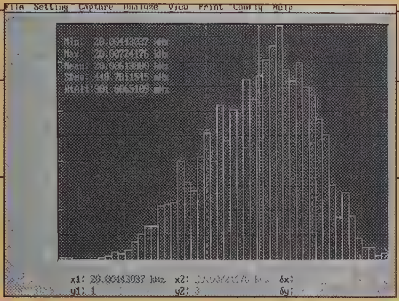
Measure timing jitter

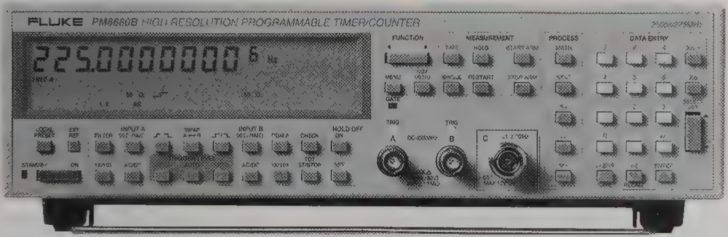
Create histograms for distribution analysis of jitter

Perform FFTs of frequency variations for modulation analysis

Collect, graph, store, recall and print measurement data







Typical TimeView™, display and analysis screen displays.

TimeView lets you view signal characteristics that you have never seen before, like VCO output frequency step response, frequency sweep characterization, frequency hopping transitions, unwanted line voltage modulation of high-stability clocks, frequency dynamics of phase locked loops, statistical jitter analysis and much more.

These powerful analysis functions are very easy to access, thanks to an intuitive user interface with pull-down menus, pop-up dialogue boxes and extensive context-sensitive help screens. All this analysis power is at your disposal for a fraction of the cost of dedicated modulation domain analyzers.

### View Data in Different Ways

PM 6680 series perform very fast frequency measurements that are stored in the counter's internal memory. TimeView receives the stored data and presents the frequency variations over time (f vs. t).

The shape of the f/t graph lets you draw many conclusions. You can zoom in on any part of the graph, as well as making accurate cursor measurements. If the graph is too noisy, a digital smoothing filter can be applied to reveal the underlying signal trends.

In FFT mode, TimeView shows and quantifies frequency modulation and reveals unwanted modulation sources, like modulation of oscillators caused by insufficiently stabilized supply voltages.

TimeView's statistical mode can show you the distribution pattern of measurements in histogram form. Important parameters like mean, standard deviation, root Allan variance and min./max. can also be calculated, either on all data or on selected samples between the cursors.

### Versatile Data Capture

TimeView gives you the freedom to capture data in several ways:

*Free running measurements* are made at maximum speed and resolution. PM 6681 makes up to 8k samples per second (PM 6680B: 2k samples/s). With PM 6681 you can also select a medium-resolution (80 ns) mode, with up to 20k samples/s.

*Repetitive sampling measurements* let you capture very fast frequency changes, like the frequency-settling behavior in a VCO, reaching a virtual sampling rate of 10 MS/s. Just like a sampling oscilloscope, you need a repetitive signal and a synchronization signal (which may be the measurement signal itself).

*Continuous back-to-back period measurements* (PM 6681 only) are performed as single-period measurements. Each individual cycle is measured, without missing a single cycle on input signals up to 40 kHz.

### File Storage and Hard Copy Output

TimeView lets you store captured data on disk for later analysis. You can make hard-copy output of any TimeView graph with most popular dot matrix or laser printers.

### Hardware Requirements

TimeView runs on any industry-standard PC with 640 kB of memory and an EGA or VGA monitor. To use TimeView for data capture, a Fluke PM 2201, National Instruments PC-IIA or Capital Equipment (CEC) GPIB interface card is required for communication with the timer/counter.

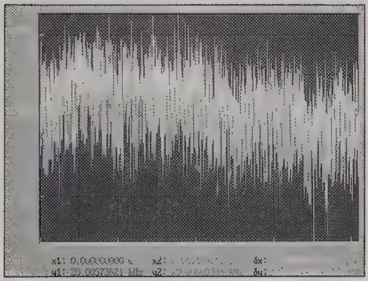


Fig. 1. Shows the variation over 2s of a 20 kHz square wave output from a pulse generator. 2048 samples are shown in the graph. This graph gives a visual impression of generator stability. Max. and min. deviations can be estimated.

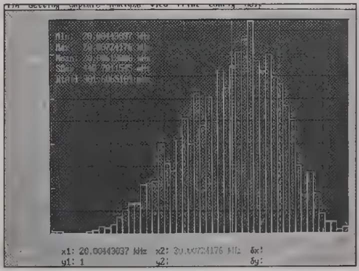


Fig. 2. Shows distribution histogram of the 2048 measurments of fig. 1 divided over 50 bins and provider statistical key parameters. Here the instability can be quantified in terms of RMS-jitter, root Allan variance and peak deviations.

# TimeView™ PC software

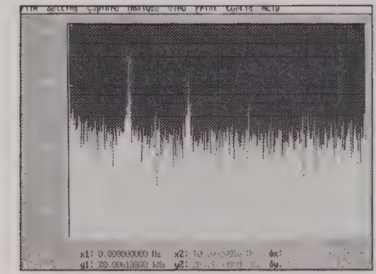

File Setting Capture Analyze View Print Config Help
x1: 0.000000000 Hz
y1: 20.00613880 kHz
x2:
y2:
δx:
δy:

Fig. 3. Shows FFT analysis of the data in fig. 1. This graph reveals frequency modulation due to insufficient regulation of the 50 Hz power supply. The main interference source is detected and corrective actions may be taken to improve design.

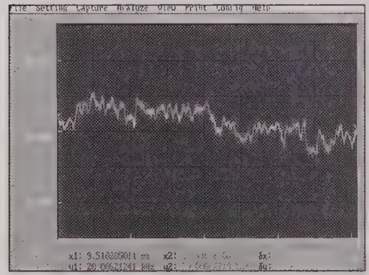

File Setting Capture Analyze View Print Config Help
x1: 9.518895011 ms
y1: 20.00621241 kHz
x2:
y2:
δx:
δy:

Fig. 4. Smoothing of raw data from fig. 1 clearly shows underlying trends.

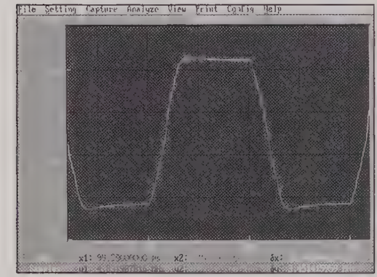
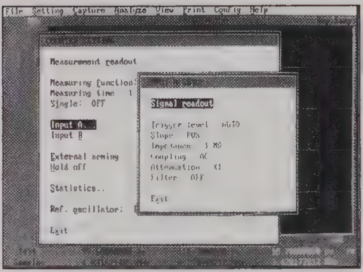

File Setting Capture Analyze View Print Config Help
x1:
x2:
δx:

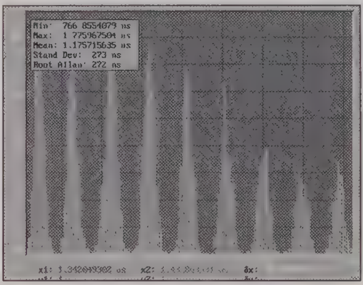
Fig. 5. TimeView is an ideal tool for anyalyzing a VCO output frequency transient. This graph was created using repetitive sampling data capture mode with 100 ns between successive samples. Note the slight "frequency over-shoot" and the frequency rise time of approx 20 µs.


File Setting Capture Analyze View Print Config Help
Measurement readout
Signal readout
Input A...
Input B
External arming
Hold off
Statistics..
Exit
Exit

```
Measuring function:
Measuring time  1
Single:  OFF
Ref. oscillator:

Trigger level  +0.10
Slope  POS
Impedance  1 MΩ
Coupling  AC
Attenuation  X1
Filter  OFF
```

Fig. 6. State-of-the-art user interface employs pull down menus and pop-up windows boxes, all of which makes TimeView very easy to learn and use.



```
Min:  766 8554079 ns
Max:  1 775967504 µs
Mean: 1.175715635 µs
Stand Dev:  273 ns
Root Allan: 272 ns
```

x1: 1.342049302 µs
x2:
δx:

Fig. 7. The distribution of the width of the 9 different CD symbols

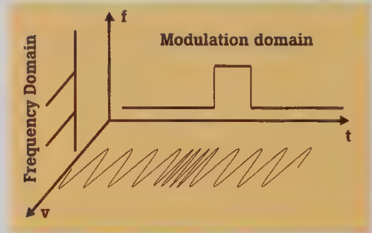

f
Modulation domain
t
Frequency Domain
v

Fig. 8. Oscilloscopes let you view voltage vs time, spectrum analyzers show voltage vs frequency, while TimeView completes the picture by showing the remaining domain; frequency vs time

## Specifications

### Technical Specifications

#### Data Capture Modes

- Free running measurements
- Repetitive sampling measurements
- Continuous back-to-back period measurements

#### Maximum samples/s (PM 6681)

Free Running Mode: 8000
Repetitive Sampling Mode: Up to 10 MHz
Continuous back-to-back period measurements: 40 k/s

#### Data Analysis Features

- Time Variation graph (measurement data vs time)
- Smoothing in time variation
- Distribution histogram
- Statistics parameters: max., min., mean, standard deviation, root Allan variance.
- FFT graph
- Cursor zoom and cursor measurements in all graphs

#### Sample Size

Max. 6143 (PM 6681, PM 6681R)
Max. 2048 (PM 6680B, PM 6685, PM 6685R)

#### System Requirements

**Computer:** IBM PC or compatible, with at least 640 kB of memory and DOS 3.30 or above.
**Monitor:** VGA/EGA.
**GPIB Interface Card:** Fluke PM 2201, National Instruments PC-IIA or Capital Equipment (CEC)
**Printer:** Most popular dot matrix or laster printers.
**Timer/Counters:** Fluke PM 6681, PM 6681R and PM 6680B with GPIB option
**Frequency Counters:** Fluke PM 6685 and PM 6685R with GPIB option
**Diskette Format:** 3.5 inch

## Ordering Information

Included in Basic Models of PM 6681 and PM 6681R Timer/Counter/Analyzers
Included in GPIB-interface of PM 6680B/– –6 (PM 9626/00)
Included in GPIB-interface of PM 6685/– –6 (PM 9626/02)
Included in GPIB-interface of PM 6685R/– –6 (PM 9626/02)

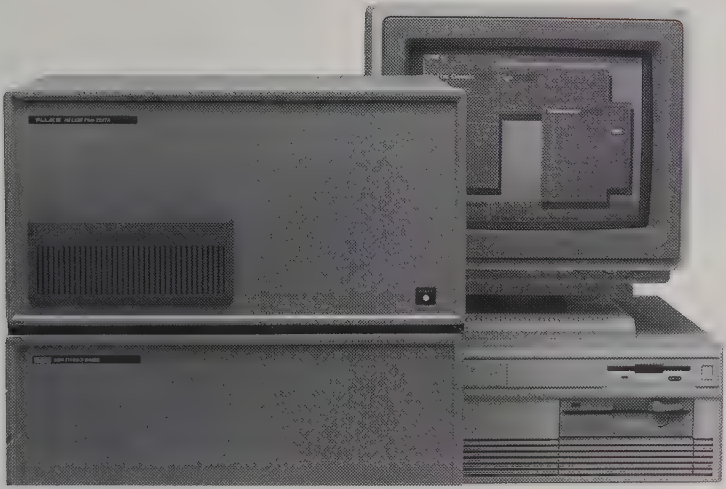
### Accessories for GPIB communication with Counter/Timers

**PM 2201** GPIB/IEEE-488.2 Interface for PC *$700*
**PM 2295/05*** Cable GPIB-IEEE, 0.5m (1.64 ft) ***Europe only***
**PM 2295/10*** Cable GPIB-IEEE, 1m (3.28 ft) ***Europe only***
**PM 2295/20*** Cable GPIB-IEEE, 2m (6.56 ft) ***Europe only***
**Y8021** Cable GPIB-IEEE, 1m (3.28 ft) ***$195***
**Y8022** Cable GPIB-IEEE, 2m (6.56 ft) ***$210***
**Y8023** Cable GPIB-IEEE, 4m (13 ft) ***$220***

The following trademarks and registered trademarks are acknowledged:
HP Laserjet : Hewlett Packard
IBM PC/AT, VGA, EGA, Proprinter : International Business Machine Corporation
MS-DOS : Microsoft Corporation

*Available in Europe only

# Data Acquisition Tools



Helios Plus

2625A/WL

2635A

2285B

New

The Fluke family of data acquisition products include both PC-based and stand-alone instruments for monitoring electrical and physical parameters such as voltage, current, resistance, temperature, pressure and flow; and can accommodate applications requiring a few channels up to several hundred channels of analog or digital I/O.

The NetDAQ™ High Speed Data Acquisition Tools give you 20 analog input channels, expandable up to 400 channels, 10 computed channels, high speed data acquisition, and Windows® software with trending.

The Wireless Logger lets you collect real time data by transmitting data using noise immune spread spectrum modulation.

The Hydra Series Data Acquisition Units offers three models: the 2620A Data Acquisition Unit, the 2625A Data Logger, and the 2635A Data Bucket which all support a wide variety of analog inputs.

Helios-I provides high accuracy, noise rejection, and resolution, across a broad range of inputs. For higher speed sampling, Helios Plus adds a fast analog-to-digital converter that provides faster data capture and alarm checking up to 1000 readings per second in burst mode.

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**Trend Link** Page 122
**Universal Input Module** Page 123
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**Helios Software** Page 128
**2280** Page 129

## Selection Guide

| | Hydra Series | | | Helios Series | | NetDAQ Series | | 2280 Series |
|---|---|---|---|---|---|---|---|---|
| Measurement | 2620A | 2625A/2625A/WL | 2635A | 2287A | 2289A | 2640A | 2645A | 2285B/2286A |
| Thermocouples | 9 Types | 9 Types | 9 Types | 11 Types | 11 Types | 9 types | 9 types | 11 Types |
| RTDs | 100Ω Pt. 385 | 100Ω Pt. 385 | 100Ω Pt. 385 | All Types | All Types | 100 Ω Pt. 385 | 100 Ω Pt. 385 | All Types |
| Resistance | To 10 MΩ | To 10 MΩ | To 10 MΩ | To 64K | To 64K | To 3 MΩ | To 3 MΩ | To 64K |
| DC Voltage Ranges | 100 mV-150V$^{7}$, 300V$^{1}$ | 100 mV-150V$^{7}$, 300V$^{1}$ | 100 mV-150V$^{7}$, 300V$^{1}$ | 64 mV-64V | 64 mV-64V | 300 mV-150/ 300V$^{9}$ | 300 mV-50V | 64 mV-64V |
| Max DC Resolution | 1 µV | 1 µV | 1 µV | 0.5 µV | 0.5 µV | 1 µV | 10 µV | 1 µV |
| AC Voltage Ranges | 300 mV-150V, 300V$^{1}$ | 300 mV-150V, 300V$^{1}$ | 300 mV-150V, 300V$^{1}$ | 250V | 250V | 300 mV-150/ 300V$^{9}$ | 300 mV-30V | 250V |
| DC Current | 4 to 20 mA$^{5}$ | 4 to 20 mA$^{5}$ | 4 to 20 mA$^{5}$ | 0 to 64 mA | 0 to 64 mA | 4-20 mA | 4-20 mA | 0 to 64 mA |
| Strain Gage | – | – | – | Yes | Yes | – | – | Yes |
| BCD | – | – | – | Yes | Yes | – | – | Yes |
| Binary | – | – | – | Yes | Yes | – | – | Yes |
| Status (Contacts) | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Counter | To 1 MHz | To 1 MHz | To 1 MHz | To 400 kHz | To 400 kHz | To 1 MHz | To 1 MHz | To 400 kHz$^{3}$ |
| Event Totalize | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| **Outputs** | | | | | | | | |
| Status or Alarms (# of chs) | 8 | 8 | 8 | 0-1000 | 0-1500 | 8 | 8 | 0-100$^{6}$, 0-1500$^{3}$ |
| Int Relays (Max) | – | – | – | – | – | – | – | 1 |
| User-Defined BCD | – | – | – | Yes | Yes | – | – | Yes |
| Analog Voltage | – | – | – | To ±10V | To ±10V | – | – | To ±10V$^{3}$ |
| Analog Current | – | – | – | 4-20 mA | 4-20 mA | – | – | 4-20 mA |
| **Features** | | | | | | | | |
| Analog Input Channels (maximum) | 21 | 21/400$^{8}$ | 21 | 1000 | 1500 | 400 | 400 | 100$^{6}$, 1500$^{3}$ |
| Basic Accuracy (dc V) | 0.02% | 0.02% | 0.02% | ±.005% | ±.005% | 0.01% | 0.02% | ±.005% |
| Speed Channels/ second | 4/17 | 4/17 | 4/17 | 16 (High Res) 1000 (Med Res)$^{2}$ | 16 (High Res) | | 45/200/1000 | 15$^{4}$ |
| Instrument Set-up and Operation | Front Panel or Computer I/F | Front Panel or Computer I/F | Front Panel or Computer I/F | Computer I/F | Computer I/F | Computer I/F | Computer I/F | Front Panel or Computer I/F |
| RS-232C/IEEE-488/ Ethernet | Std/Opt/NA | Std/NA/NA | Std/NA/NA | Std/NA/NA | Std/NA/NA | NA/NA/Std | NA/NA/Std | Opt/Opt/NA |
| 12V DC Operation | Yes | Yes | Yes | Opt | Opt | Yes | Yes | Yes |
| Graphics | Via Host | Via Host | Via Host | Via Host | Via Host | Via Host | Via Host | Plot |
| Permanent Data Storage | Host | NV RAM | PC Card | Host | Host | Host | Host | 3.5" Disk$^{3}$ |
| Built-in Printer | – | – | – | – | – | – | – | Yes |
| Battery Back-up | Program, Clock, Data | Program, Clock, Data | Program, Clock, Data | Definitions, Clock | Definitions, Clock | Program, Clock | Program, Clock | Program, Clock |
| PC Application Software | Yes | Yes | Yes | Yes | Yes | Yes | Yes | – |
| Page Number | 113 | 113 | 113 | 124 | 124 | 108 | 108 | 129 |

*1) 300V from front panel and channels 1 and 11*
*2) In burst mode A/Ds operate in parallel for even higher effective reading rates, 2287A only*
*3) Applies to 2286A only*
*4) Multiple A/Ds in 2286A system increase speed*
*5) Requires the 2620A-101 4-20mA current shunt strip set*
*6) Applies to 2285B only*
*7) 100 mV range available for thermocouple measurements and dc volts measurements when under computer control.*
*300 mV range is minimum front panel selectable range.*
*8) 400 channels 2625A/WL only*
*9) 300V channels I and II*

# Data Acquisition Tools

## Introduction

In manufacturing and continuous process industries there is an increasing need for data acquisition to more closely monitor and document processes, tests and procedures. Worldwide competitive pressures to reduce costs are forcing companies to refine or redesign development and production processes. Compliance with regulations for environmental, health, safety, energy consumption, and quality standards, including ISO 9000, requires that companies test, report and archive more data.

Flexibility of measurement input types, adaptability of instrument placement and operating environments, integrated hardware and software, and application software support are hallmarks of Fluke data acquisition tools. These tools offer you a selection of scanning speeds, measurement accuracy, communications options, system sizes, application software and instrument packaging so you can create a system to meet your needs.

Fluke's reliable data acquisition tools are employed throughout the world in applications as diverse as automotive testing, power plant monitoring, paperless chart recording in steel mills, production monitoring for appliance manufacturing and product testing in semi-conductor manufacturing.

From evaluating a new product design through life testing, to production process monitoring and final test, Fluke's data acquisition tools help you improve the quality of your products and processes.

### Research and Development

Data acquisition equipment is useful in helping to improve products or processes. In R&D applications where testing requirements are often short-term and extremely varied, it is important that the equipment be easy to set up and configure to get the required results quickly. The compact Hydra Data Acquisition Series provides an interface that can be quickly adapted to the needs of a number of users, and its portability allows it to travel around the lab or in the field as required.

### Design Testing

During product development, designs must be tested to ensure proper performance. The engineer or technician often measures various parameters on the bench or places the prototype in an environmental chamber to conduct reliability or life cycle tests. Small, portable data loggers capable of measuring a variety of parameters are an asset in this type of application. Because data analysis is most readily performed in a PC, all Fluke data acquisition tools gather data in a PC-compatible format, enabling the user to analyze the results using spreadsheet or database programs.

### Production Testing

There are several areas in the production environment that benefit from the use of data acquisition. An example of this is in the burn-in area of product testing. Here, data acquisition instruments gather measurement data while the product is being environmentally stressed. Manufacturers strive to discover any possible flaw in their product at the earliest possible moment, knowing it is far less expensive to find and change a faulty part at subassembly level, than to troubleshoot a finished product. Ultimately, their goal is to minimize failures in the hands of their customers.

### Equipment Monitoring

Various machinery used throughout production areas needs to be monitored to prevent breakdown at a time. Data acquisition equipment is often used for "predictive maintenance." The maintenance staff monitors specific parameters on each machine on a regularly scheduled basis, then if measurement readings drift too far from the ideal, maintenance is scheduled for a time that causes the least impact on production. Data gathered in PC-compatible format can be used to analyze the results and look for trends.

### Wireless Applications

New implementations of spread spectrum radio technology designed for secure military communications has given birth to a new category of data acquisition equipment – Wireless Data Loggers. The Fluke Wireless Logger allows users within any industry to setup remote test or monitoring sites on a moment's notice and begin real time monitoring within minutes via a secure, noise immune wireless data link to a PC base station. The 2625A/WL Wireless Logger is a portable, easy-to-use wireless data acquisition tool that enables quick, immediate data collection and transmission to a PC from locations once considered too remote, inaccessible or environmentally hostile for real time monitoring systems. Each satellite accommodates up to 20 analog measurement channels that can be set up within minutes and is ideally suited for PC-based data acquisition applications where quick, convenient setup is important.

### Remote or Mobile Applications

There are many applications in remote areas, including in-vehicle testing that require data acquisition instruments operating in dc power. These types of instruments are designed to save the data in a PC-compatible format for analysis after the test is complete. In the case of gathering data in remote areas, the data acquisition equipment is often connected via modem to a computer at another site and data is transferred on regular intervals.

### Application Software Completes the System

The Fluke family of data acquisition tools addresses a wide variety of applications, but the software for these systems is highly user-friendly. Window's-based software offers ease of set-up and operation. Advanced trending lets you scroll through real time and historical data, view data from several channels on one screen, create X-bar R charts or import the data instantly into Lotus® 1-2-3® or Microsoft® Excel™ for further analysis.

# Data Acquisition Tools

## NetDAQ™ High Speed Data Acquisition Tools

FREE
FLUKE
SIGNAL CONDITIONING

High speed data acquisition, up to 1,000 readings per second

20 analog input channels expandable up to 400 channels

Extensive optional plotting and trending capabilities

Optional wall, cabinet, or rack mounting

May be connected to Ethernet networks

NetDAQ High Speed Data Acquisition Tools give you a powerful combination of hardware and software that's ideal for small-to-medium scale process monitoring and test systems. They answer the escalating need for measurement, recording, and analysis tools that enable you to improve quality, maximize process efficiency and meet regulatory requirements. Building blocks of 20 channels can be expanded into an integrated system of up to 400 channels. Choose between two models for the speed (up to 1000 rps), accuracy (up to 0.01%), and packaging choices you need. All NetDAQs utilize Fluke's patented Universal Input Module which accepts any combination of analog input types for each of its 20 channels - without the need for external signal conditioning. Simply pre-wire the Universal Input Module to directly measure temperature, DC volts, AC volts, resistance, 4-20 mA, and frequency. (For more information refer to the Universal Input Module in this section. See page XX.)

**Set up your NetDAQ system the way you want it.** You can set up your NetDAQ system in several different ways. Configure an isolated system, daisy-chaining as many as 20 NetDAQ units to your PC with a high-speed communication line. This is a quick, simple way to send real time data directly to a PC (see fig. 1).

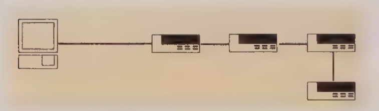


Fig. 1

**Or, add NetDAQ units directly to your company's network.** Sharing the network cabling and hardware that's already installed saves you time and expense. And, if you wish, all the users on your network have an easy way to access the data you're collecting (see fig. 2).

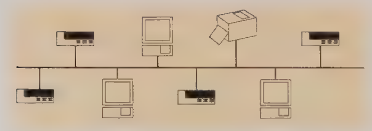


Fig. 2

A third configuration option is to **add an isolated NetDAQ system to your company's network.** This method isolates your data acquisition application from your company's network while still providing the advantages of multi-user viewing. High-speed applications won't be slowed down by network operations, and critical applications are completely protected from network failure (see fig. 3).

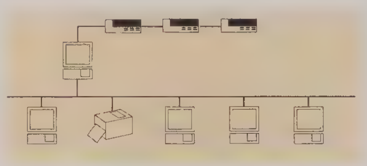


Fig. 3

**High-speed communication makes it easier to get results.** No matter how you set up your data collection system, high-speed networked communication offers you a number of benefits. It gives you the ability to implement distributed applications with NetDAQ units in multiple locations. In these applications, multiple PC users can monitor data, in real time, as it is collected. Support for up to 3,000 readings per second (rps) from multiple instruments keeps throughput high. And you're ensured of highly reliable results, even over long distances.

NetDAQ supports both common Ethernet network wiring types - 10Base2 (coax) and 10BaseT (twisted pair) - and all major network operating systems including: Novell, Banyan Vines, LAN Manager, Windows® for Workgroups or any other Ethernet network that uses TCP/IP communications protocol.

**Powerful application software makes real time decisions easier.** The NetDAQ Logger for Windows software makes configuring and reconfiguring your system a snap. This intuitive Microsoft® Windows-based software plots your data graphically, so you can get right down to making decisions. With its advanced trending capabilities, you can look at real time data in context of historical data, compare multiple channels, or zoom in on a particular time span. You can also print plots directly from NetDAQ Logger. For further analysis or to generate reports, cut and paste either plots or data into off-the-shelf software such as Microsoft Excel, Lotus 1-2-3, Quatro Pro, or Microsoft Word. See the NetDAQ Logger for Windows section on page XXX for more details.

**The Universal Input Module makes configuration a snap.** NetDAQ's Universal Input Module lets you easily measure just about any electrical or physical parameter without changing hardware or adding external signal conditioning. Any combination of DC voltage, AC voltage, thermocouples, current, RTD, resistance (2- or 4-wire), or frequency measurement can be connected directly to the input module. Fluke's proprietary signal conditioning capability is built directly into the NetDAQ unit, thus eliminating the need to purchase external conditioning modules. For more information on the Universal Input Module, see page XX.

The 2640A NetDAQ can measure up to 300V at up to 100 rps. The 2645A is the first instrument of its type capable of directly measuring multiple inputs of up to 50V at 1000 readings per second. With Mx+B scaling you can convert a wide range of signals (0-10V or 4-20 mA) into standard engineering units.

Using Fluke's patented technology, thermocouple reference junction compensation occurs automatically, by sensing the temperature of the input module's isothermal block. Excellent isothermal performance is achieved by thick copper layers embedded just beneath connection points, and an enclosure that protects inputs from changing environmental conditions. And strain relief protects sensor wires from accidental disconnection.

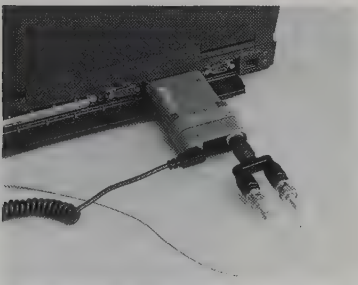
For calibration, or use in another application, you can leave your field connections set up at your site and merely plug and unplug the module when you want to move the NetDAQ unit.

**Choose the level of performance you need.** NetDAQ systems are modular and expandable up to 400 channels. With the 20-channel units as building blocks, you can buy the number of channels you need for your application. Later, add units if you need them.

Because every application is different, we offer a selection of accuracies and measurement rates to match your application needs. The 2640A offers 0.01% vdc - 0.3°C TC accuracy and 18 bit resolution, scanning 6 - 100 channels per second. The 2645A can scan at 48 to 1000 channels per second with 16 bit resolution and 0.01% vdc - 0.6°C TC accuracy.

# Data Acquisition Tools

## NetDAQ™ High Speed Data Acquisition Tools



Hook up your NetDAQ system directly to your PC's parallel port. Simply use the 264XA-802 Adapter. This is ideal for portable computers or mobile applications.

All models offer a totalizer input channel which counts up to 4,294,967,295 "on/off" events. This channel is continuously sampled and is recorded with each scan of the other input channels.

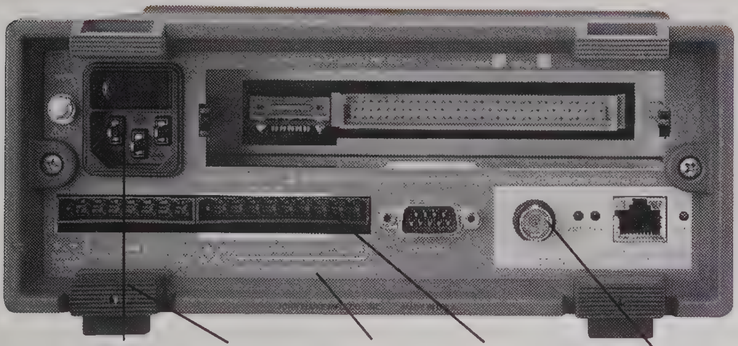
Each analog and calculated channel has two user-defined alarm limits which can be independently configured as high, low, or off, and assigned to one of the eight digital I/O lines which can initiate action based on alarm conditions. Or these digital I/O lines can be used independently as inputs for contact closures, switches, or TTL levels.

**Accurate time stamping.** NetDAQ's non-volatile, on-board clock time stamps data as measurements are taken ensuring proper recording regardless of network traffic levels. NetDAQ's on-board memory buffers data in the event that network traffic prevents timely delivery of data to the host PC.

**Choose the packaging that suits your application.** The 2640A and 2545A NetDAQ units are housed in Fluke's standard, field-tough metal case designed to resist effects of high EMI and RFI environments. Both models have a simple front panel interface with just eight buttons for local monitoring of all input measurements, and checking and setting communication parameters.

If you need your NetDAQ close at hand but out of the way, either unit can be permanently mounted on a wall, or in a rack or cabinet with optional mounting accessories. For hazardous conditions, such as caustic or toxic environments, high temperatures or humidity, the optional NEMA-4X enclosure provides durable protection and easy access.

**Easy calibration for your NetDAQ.** NetDAQ units are extremely stable, but when you do need to calibrate one, we've made it very easy. The optional service manual gives you simple, step by step calibration instructions. (An RS-232 interface is provided on the NetDAQ units for calibration.) The service manual also provides a disk containing the Fluke MET/CAL procedure.



**Power Supply**
Connect to any line source of 107-264 VAC (50-60 Hz), or to 9-16 VDC for operation where line power is not available.

**External Trigger**
Use real-world events to activate scanning.

**Digital I/O**
Assign eight digital I/O lines as inputs, or to act as alarm outputs for any input channel.

**Totalizer**
Count up to 4,294,967,295 "on/off".

**Interfacing**
Ports for both 10Base2 (coaxial) and 10BaseT (twisted pair) are provided for convenient network cabling.

| 2640A | 2645A |
|---|---|
| • 100, 50, 6 channels/second<br>• 18 bit A/D resolves 1 µV and .02°C<br>• 300V maximum measurement input<br>• Built-in signal conditioning<br>• Real time on-board clock<br>• -20 to 60°C (-4 to 140°F) operating temperature | • 1000, 200, 48 channels/second<br>• 16 bit A/D resolves 10 µV and 2°C<br>• 50V maximum measurement input<br>• Built-in signal conditioning<br>• Real time on-board clock<br>• -20 to 60°C (-4 to 140°F) operating temperature |

# NetDAQ™ High Speed Data Acquisition Tools

## Specifications

**Channel Capacity:** Analog inputs: 20;
Computed channels: 10;
Digital I/O & Alarm Outputs: 8 total;
Totalizer: 1.

**Computed Channels:** 10 computed channels can be created by processing analog input channels and other computed channels with the following methods*: Addition, subtraction, multiplication, division, log, natural log, exponent, square root, absolute value, integer function, average (average of a group of channels), difference (difference between any two channels), difference (between a channel and a group of averaged channels)

### Scan Speed:

**2640A:**
Slow: 6 channels/second nominal; Medium: 41 (50 Hz), 48 (60 Hz) channels/second nominal; Fast: 143 channels/second nominal

**2645A:**
Slow: 45 (50 Hz), 54 (60 Hz) channels/second nominal; Medium: 200 channels/second nominal; Fast: 1000 channels/second nominal

### Analog to Digital Converter:

**2640A:** Multi-slope type, linear to 18 bits.
**2645A:** Multi-slope type, linear to 16 bits.

### Common Mode Rejection (slow scan):

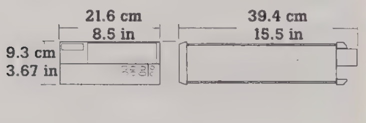
**2640A:** AC: ≥120 dB (50/60 Hz, ±0.1% max 1 kΩ source imbalance); DC: ≥120 dB.
**2645A:** AC: ≥100 dB (50/60 Hz, ±0.1% max 1 kΩ source imbalance); DC: ≥100 dB.

### Normal Mode Rejection (slow scan):

50 dB @ 50/60 Hz, ±0.1%

### Common Mode and Normal Mode Voltage Maximum:

**2640A:** 300 VDC or VAC rms (channels 1,11); 150 VDC or VAC rms (all other channels).
**2645A:** 50 VDC or 30 VAC rms (all channels).
**Power:** 107 to 264 VAC, 50 or 60 Hz (<15W), or 9 to 16 VDC (<6W).
**Temperature, Humidity (non-condensing):** -20°C to 60°C. Storage: -40°C to 75°C, 5% to 95% RH.
**Electromagnetic Interference (EMI):** Passes FCC EMI Class B Equipment, Vfg. 243, European Norms EN50081-1 and EN50082-1 (qualifying NetDAQ for CE)
**Weight:** 3.7 kg (8.2 lbs.).



### Measurement Accuracy

| Thermocouples[4] | | Accuracy[1,3], $3\sigma$, ± °C | |
|---|---|---|---|
| | | 90 Day, Slow | |
| Type | Temp (°C) | 2640A | 2645A |
| J | -100 to 80 | 0.45 | 0.8 |
| | 80 to 230 | 0.35 | 0.7 |
| | 230 to 760 | 0.4 | 0.65 |
| K | -100 to -25 | 0.55 | 1.0 |
| | -25 to 120 | 0.4 | 0.8 |
| | 120 to 800 | 0.5 | 0.9 |
| | 800 to 1372 | 0.7 | 1.2 |

| DC Voltage | Accuracy[1], $3\sigma$, ±(% input + V) 18 to 28°C | |
|---|---|---|
| | 90 Day, Slow | |
| Range | 2640A | 2645A |
| 300 mV | 0.01%+15 μV | 0.01%+40 μV |
| 3V | 0.01%+1 mV | 0.01%+3 mV |
| 30V | 0.01%+1 mV | 0.01%+3 mV |
| 150/300V | 0.01%+10 mV | 0.01%+30 mV |

| RTD (Pt 100) | Accuracy[1,2], $3\epsilon$, ± °C (4-wire) | |
|---|---|---|
| | 90 Day, Slow | |
| Temperature °C | 2640A | 2645A |
| -200 | 0.08 | 0.15 |
| 0 | 0.12 | 0.20 |
| 100 | 0.14 | 0.22 |
| 300 | 0.20 | 0.29 |
| 600 | 0.4 | 0.62 |

1. Total instrument accuracy for 1 year following calibration (unless otherwise stated). Ambient operating temperature 18 - 28°C. Includes A/D errors, linearization conformity, initial calibration error, isothermality errors, and reference junction conformity. (Sensor inaccuracies not included.) Relative humidity up to 90% non-condensing (except up to 70% for the 300 kΩ, 3 MΩ, and 10 mΩ ranges).
2. DIN/IEC 751 only, assumes no lead-wire resistance errors.
3. 2640A: Resolution is 0.02°C or 0.04°F over the useful range of base metal thermocouples (J, K, T, E, N) and 0.1°C or 0.2°F resolution for types R, S, B, and C with slow scan.
   2645A: Resolution is 0.2°C or 0.4°F over the useful range of base metal thermocouples (J, K, T, E, N) and 1.0°C or 2.0°F resolution for types R, S, B, and C with slow scan.
4. Open thermocouple detection is performed on each thermocouple channel unless defeated by computer command.

## Ordering Information

### Models

**2640A** NetDAQ High Speed Data Acquisition Unit *$3995*
**2645A** NetDAQ High Speed Data Acquisition Unit *$3995*

### Included with instrument

Universal Input Module, 4m Ethernet Cable, 50Ω Terminator, Y BNC Adapter, T thermocouple, power cable, and user's manual.

### NetDAQ Systems

20 Channel NetDAQ System (1 unit)
40 Channel NetDAQ System (2 units)
60 Channel NetDAQ System (3 units)
80 Channel NetDAQ System (4 units)
100 Channel NetDAQ System (5 units)

*Systems available up to 400 channels

### Options

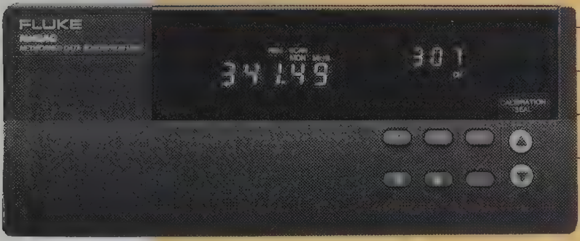
**264XA-801** Ethernet Card (10Base2, 10BaseT) *$295*
**264XA-802** Parallel-to-Lan Adapter (10Base2) *$345*
**2620A-101** 10Ω Current Shunt Strip *$50*
**26XXA-600** Portable Battery Pack *$195*

### Accessories

**Y2641** 19" Rackmount kit, single/dual *$125*
**Y2642** Wall/Cabinet Mounting Plate *$70*
**Y2643** 4m Ethernet Cable Kit *$85*
**Y2644** NEMA-4X (IP65) Enclosure *$480*
**80i-410** Clamp-on DC/AC Current Probe *$179*
**80i-1010** Clamp-on DC/AC Current Probe *$297*
**942615** NetDAQ Service Manual *$80*

# NetDAQ™ Logger for Windows®

Windows-based application software for 2640A and 2645A NetDAQ mainframes



No programming required – Easy, menu-based configuration–quickly configure and start data collection

Extensive plotting and trending capabilities

Exchange data with other Windows programs in real time with DDE

Intuitive interface through Windows interface

On-line help available at any time

The NetDAQ Logger for Windows software makes configuring and reconfiguring your NetDAQ system a snap. This intuitive Microsoft® Windows-based software plots your data graphically, so you can get right down to making decisions. With its advanced trending capabilities, you can look at real time data in context of historical data, compare multiple channels, or zoom in on a particular time span. You can also print plots directly from NetDAQ Logger. For further analysis or to generate reports, cut and paste either plots or data into off-the-shelf software such as Microsoft Excel, Lotus® 1-2-3®, Quatro Pro or Microsoft Word.

## Quick setup and configuration.

You will find that NetDAQ Logger's highly intuitive, Microsoft Windows-based user interface makes this the easiest data acquisition system you've ever used. Quickly configure or reconfigure your applications without programming. Just use the pull-down menus, dialog boxes and icons to set up applications, acquire data, or analyze trends. On-line help is always one click away.

The instrument configuration window, for example, lets you select channel configurations, scanning intervals, alarms, engineering units, etc., simply by clicking on buttons or "filling in the blanks." The software supports up to 20 analog input channels per NetDAQ, and up to 20 measurement NetDAQs (400 channels total). You can also assign two alarms on each channel.

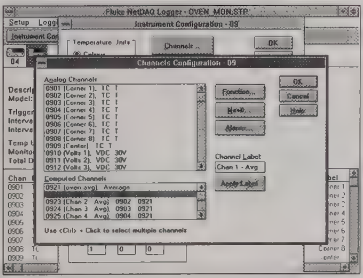
NetDAQ Logger speaks your language, too. At software installation, choose from English, French or German.

## Create a "Virtual Instrument" of Up to 400 Channels.

Multiple NetDAQ units – distributed throughout your facility – can be set up in grouped mode to create a "virtual instrument." Measurements are synchronized, and all data can be directed to a single data file. As with other setups, you can view data from all channels, simultaneously, on a single screen.

## Computed Channels Save Time.

In addition to its 20 analog input channels, each NetDAQ unit supports 10 computed channels. Calculations include: addition, subtraction, multiplication, division, log, natural log, exponent, square root, absolute value, integer function, averages (average of a group of channels), differences (difference between any two channels) or difference from an average. This last calculation is handy for applications such as monitoring ovens, engines, or compressors when you're looking for hot and cold spots. Automatic Mx+B calculations allow you to display electrical signals in engineering units. For example, a 4-20 mA input can be displayed as kPa or PSI.



Analog Channels

```
0901 (Corner 1), TC T
0902 (Corner 2), TC T
0903 (Corner 3), TC T
0904 (Corner 4), TC T
0905 (Corner 5), TC T
0906 (Corner 6), TC T
0907 (Corner 7), TC T
0908 (Corner 8), TC T
0909 (Center), TC T
0910 (Volts 1), VDC 30V
0911 (Volts 2), VDC 30V
0912 (Volts 3), VDC 30V
```

Channel Label: Chan 1 - Avg

Computed Channels

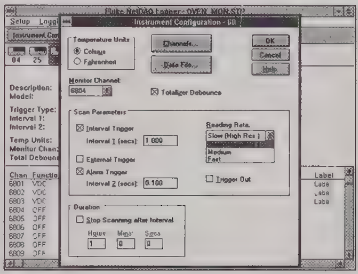
```
0921 (oven avg), Average
0923 (Chan 2 Avg), 0902 0921
0924 (Chan 3 Avg), 0903 0921
0925 (Chan 4 Avg), 0904 0921
```

Use <Ctrl> + Click to select multiple channels

Point and click to configure each of NetDAQ's 20 analog channels and 10 computed channels.

## Advanced Trending Capabilities.

With NetDAQ Logger's comprehensive trend plotting package, you control how your data is displayed. You can quickly scroll through real time and historical data, or view data from all channels, simultaneously, on a single screen. Or, you can plot one or multiple channels real time, looking at current data in context of historical data, even superimposing channels on other channels. To record comments for future reference, simply tag notes to any point on a curve, which become a permanent part of the data file. NetDAQ Logger will also calculate basic statistics such as mean and standard deviation. It will also create X-bar R charts and X-Y scatter diagrams (e.g. plot temperature vs. relative humidity, or frequency vs. voltage.) For more extensive data analysis, import your data into a spreadsheet like Lotus or Excel. If the data file is too big for your spreadsheet, simply zoom into and isolate the data you want, and export only that portion to your spreadsheet.



Temperature Units
● Celsius
○ Fahrenheit

Monitor Channel: 6804

☒ Totalizer Debounce

Scan Parameters
☒ Interval Trigger
Interval 1 (secs): 1.000
☐ External Trigger
☒ Alarm Trigger
Interval 2 (secs): 0.100
Reading Rate: Slow (High Res) / Medium / Fast
☐ Trigger Out

Duration
☐ Stop Scanning after Interval
Hours: 1 Mins: 0 Secs: 0

```
6801 VDC
6802 VDC
6803 VDC
6804 OFF
6805 OFF
6806 OFF
6807 OFF
6808 OFF
6809 OFF
```

NetDAQ Logger makes it easy to configure your channels, data files, scanning intervals, and measurement speeds. You can even configure NetDAQ Logger to acquire data for a set time period and stop logging automatically.

## Multiple Users can View Data from Multiple Locations.

While one PC controls a NetDAQ system, multiple PCs can simultaneously view NetDAQ data. By running NetDAQ Logger's trending software on their individual PCs, each user can analyze the data being collected in his or her own way. In a typical application, Quality Control can audit the data from a monitoring station. The production manager can monitor test progress hour-by-hour from her office. The engineer can watch the results in real time right from the test site, or if he's off-site and an alarm occurs, he can be notified and check on the test from the nearest PC.

## Easy Interfacing to Other Software for Analysis and Reports.

The data and plots you generate with NetDAQ Logger can be easily cut and pasted into other off-the-shelf software. Or, establish real time DDE links to spreadsheets like Excel or Lotus 1-2-3, or WonderWare "InTouch" software. Real time data is entered directly into the linked file once every second.

For hardcopy documentation, NetDAQ Logger prints plots, or you can cut and paste plots or data into a word processing application like Microsoft Word or other software when generating presentation-quality reports.

### The Developer's Toolbox.

For OEMs or system integrators building larger NetDAQ systems, a developer's toolbox is available for the creation of custom NetDAQ programs. The developer's toolbox works in conjunction with NetDAQ Logger for Windows and allows you to access NetDAQ data and create custom user interfaces.

The developer's toolbox provides function calls in both C and Visual BASIC.

### NetDAQ Logger for Windows Software Specifications

### System Requirements:

- System: IBM PC Compatible with an Intel 386 microprocessor or greater (486 recommended);
- Hard Disk Drive: hard disk drive with 5 MB of free space;
- Floppy Disk Drive: 1.44 MB (3½") floppy disk drive;
- Memory: As required to support the Windows operating system;
- Monitor: Any monitor supported by Windows, (color recommended);
- Operating System: Microsoft Windows version 3.1 or later.

**Number of NetDAQ Units Supported:** Up to 20 NetDAQ units (400 analog channels) can be supported by a single copy of NetDAQ Logger for Windows.

### NetDAQ LabWindows Driver

National Instruments LabWindows® provides programmers with a complete, easy-to-use environment for the generation and execution of data acquisition software written in Microsoft QuickBASIC,® Professional BASIC or C. LabWindows reduces development time by providing libraries that cover every stage of program development and execution – data acquisition, data analysis, and data presentation.

The LabWindows programming environment provides an editor and a large number of standard functions and libraries, including a new Graphical User-Interface Library. User-interface functions include menus, numeric displays, slide switches, ring controls, simulated LEDs, text boxes, graphs and strip charts. PCX images can be used to create advanced displays, e.g. test system schematics or process diagrams.

The NetDAQ LabWindows driver is available from Fluke. Contact your local Fluke representative for more information. LabWindows is available from National Instruments.

### NetDAQ LabVIEW Driver

National Instruments® LabVIEW® is a graphical programming system for data acquisition, data analysis, and data presentation. LabVIEW offers an innovative programming methodology in which users graphically assemble software modules called virtual instruments (VIs). Users build VIs to acquire data and then analyze the data and present the results through a graphical user interface. VIs allow users to focus on the application using familiar block diagrams instead of spending time with a text-based programming language.

With LabVIEW, users build VIs instead of writing programs. Front panel user interfaces can quickly be created which provide interactive control of software systems. To specify functionality, users intuitively assemble block diagrams. The block diagram is the actual program, allowing users to avoid the time-consuming task of converting ideas into cryptic text-based code.

The NetDAQ LabVIEW driver is available from Fluke. Contact your local Fluke representative for more information. LabVIEW is available from National Instruments.

## Ordering Information

### Application Software

### Models

**264XA-901** NetDAQ Logger for Windows, Isolated System ***$1295***
**264XA-902** NetDAQ Logger for Windows, General Network ***$1995***
**264XA-902U** NetDAQ Logger for Windows, Network Upgrade ***$995***
**264XA-903** NetDAQ Developer's Toolbox* ***$350***
**26XXA-904** Trend Link for Fluke ***$895***

* Developer's Toolbox requires NetDAQ firmware version 2.0 or higher and NetDAQ Logger for Windows version 2.0 or higher.

# Data Acquisition Tools

## 2620A Hydra Data Acquisition Unit

21 analog input channels

Measures Vdc, Vac, thermocouples, RTDs, resistance, and frequency

Standard RS-232C interface

Optional GPIB IEEE-488 interface (2620A only)

Easy set up through front panel or remotely via PC

Application software for PC included: Hydra Starter Package

Other available application software: Hydra Logger for Windows, Hydra Logger (DOS) Trend Link for Fluke

AC or DC operation enables Hydra to work where line power is not available

2620A &
2625A
2635A

## 2625A Hydra Data Logger

All the features of the Hydra 2620A, plus:

Non-volatile data memory for mobile/remote monitoring (2047 scans)

Supports operation with switch-selectable auto-answer modems

## 2635A Hydra Data Bucket

All the features of the 2620A and 2625A, plus:

Increased data memory capability using removable memory card

Remote instrument set-up: you can load a stored configuration from the memory card

Faster data transfer: using RS-232C (top speed of 38.4k baud) or by removing the memory card and using the memory card drive attached to your PC's parallel port

The Hydra Series is available in three models to fit many application requirements. The 2620A Hydra Data Acquisition Unit is a compact front end for use with your PC. The portable 2625A Hydra Data Logger features non-volatile memory that stores more than 2000 scans, for stand-alone applications. And the 2635A Hydra Data Bucket with its removable memory card for data and set-up storage is the most versatile model – ideal for remote monitoring applications.

All models are easy to set up and reconfigure from the front panel. Additionally, all units have bi-directional communication via RS-232C, which enables control from a host computer. The RS-232C interface also supports stand-alone use with a serial printer. An optional GPIB/IEEE-488* interface is available for the 2620A only.

The Hydra Series is extremely rugged and able to operate in diverse environments. Its operating range is 0 to 60°C, and it is tested to stringent shock and vibration standards. Hydra's sturdy metal chassis effectively shields against electromagnetic interference, maintaining high measurement accuracy on low level signals. The analog circuitry is also isolated from the digital circuitry so you can measure high voltages directly (up to 300V ac rms). And it conforms to I.E.C., C.E. and CSA safety standards. What's more, all set-up information is battery-backed, so it's immune to power failure. Hydra will return from a power loss and resume scanning, while all configuration information and stored data remain intact.

### Universal Input Module

The removable universal input module enables fast, convenient set-up and reconfiguration. Any combination of dc voltage, ac voltage, thermocouple, RTD, resistance, or frequency measurements can be connected to the input module without the need for additional signal conditioning. Thermocouple reference junction compensation is automatically performed by sensing the temperature of the input module's isothermal block. For applications with multiple measurement locations, purchasing additional input modules provides the ability to quickly connect and disconnect a Hydra to these various sites while leaving all sensor wiring intact.

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* The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

### PC Operation

The Hydra 2620A Data Acquisition Unit provides a low-cost solution for PC-based applications requiring up to twenty analog inputs. Hydra can be connected in real time to your PC. Hydra's bi-directional RS-232C interface and computer command set provide complete remote control, duplicating all front panel functions. For IEEE-488 based systems, the 2620A/05 comes equipped with an IEEE-488 interface which duplicates the remote capabilities of the RS-232C interface.

### Software Included

The **Hydra Starter Package** is included with the purchase of any Hydra instrument. Hydra Starter Package will run on any IBM® PC or compatible computer.

The Hydra Starter Package supports use of a single Hydra connected to a PC via RS-232C. Its menu-driven user interface makes it extremely easy to use. You configure Hydra from its front panel, connect it to the PC, then start your test. During operation, the Starter package displays readings of all channels in real-time and automatically logs the data to a Lotus 1-2-3® compatible file – select either ASCII or binary format. Additionally, when used with the 2625A or 2635A, the Starter package can retrieve the contents of the non-volatile data memory – again storing them in a 1-2-3 compatible ASCII file.

### Software Available

The **Hydra Logger Package** is an optional DOS Based software package that allows you to set up all channels and functions of one or two Hydras using your PC.

The Logger Package controls Hydra's scanning, collects data, graphs any eight channels in real-time, and creates a data file which may be directly imported into Lotus 1-2-3 or other spreadsheets for further analysis. All these capabilities are controlled via simple menus on your PC's display, either through a keyboard or mouse.

### Hydra Logger for Windows

The **Hydra Logger for Windows** software package gives you a powerful data acquisition system when combined with a Hydra instrument and your PC. Hydra Logger gives you control of Hydra's powerful functions, including scanning, signal conditioning, sensor linearization, alarm detection and reporting, non-volatile data memory, advanced trend plotting and more. "Logger" supports the 2625A and 2635A Hydra models. With Hydra Logger's optional, trend plotting package, Trend Link for Fluke, you can control how your data is displayed. You can quickly scroll through real time and historical data, or view data from all channels simultaneously, on a single screen. Or, you can plot one or multiple channels in real time, even superimposing channels on other channels. Zoom in and out features and statistics make this optional package ideal for report and analysis needs. For more information, see page 122.

### Hydra LabWindows Driver

National Instruments LabWindows® provides programmers with a complete, easy-to-use environment for the generation and execution of data acquisition software written in Microsoft QuickBASIC,® Professional BASIC or C. LabWindows reduces development time by providing libraries that cover every stage of program development and execution – data acquisition, data analysis, and data presentation.

The LabWindows programming environment provides an editor and a large number of standard functions and libraries, including a new Graphical User-Interface Library. User-interface functions include menus, numeric displays, slide switches, ring controls, simulated LEDs, text boxes, graphs and strip charts. PCX images can be used to create advanced displays, e.g. test system schematics or process diagrams.

The Hydra LabWindows driver is available from Fluke. Contact your local Fluke representative for more information. LabWindows is available from National Instruments.

### Hydra LabVIEW Driver

National Instruments® LabVIEW® is a graphical programming system for data acquisition, data analysis, and data presentation. LabVIEW offers an innovative programming methodology in which users graphically assemble software modules called virtual instruments (VIs). Users build VIs to acquire data and then analyze the data and present the results through a graphical user interface. VIs allow users to focus on the application using familiar block diagrams instead of spending time with a text-based programming language.

With LabVIEW, users build VIs instead of writing programs. Front panel user interfaces can quickly be created which provide interactive control of software systems. To specify functionality, users intuitively assemble block diagrams. The block diagram is the actual program, allowing users to avoid the time-consuming task of converting ideas into cryptic text-based code.

The Hydra Labview driver is available from Fluke. Contact your local Fluke representative for more information. Labview is available from National Instruments.

### Printer Operation

For stand-alone use without a PC, the print function in all Hydra models controls the data flow to a local serial printer. Autoprint has three operating modes: print all data; print all data if any channel is in alarm; or print all data if any channel has transitioned into or out of alarm. The 2625A Hydra Data Logger and the 2635A Data Bucket are also able to store and print data simultaneously, thereby allowing you to access the data later for further analysis on your PC.

### Data Logger Operation

The Hydra 2625A Data Logger is differentiated by its built-in non-volatile recording capability. This feature makes data capture and offline storage very flexible and convenient. The memory holds 2047 sets of readings on each of the 21 analog input, 12 digital I/O, and totalizer channels – enough to hold one scan per minute for more than 24 hours. The Hydra Data Logger is ideal for recording data during environmental stress screening, thermal testing, design testing, and other applications that require data logger with up to twenty analog measurement channels.

### External Disk Drive

Another possibility to store data is to use the 262XA-802 External Disk Drive. By connecting it to Hydra's serial output (2620A and 2625A), up to 325,000 readings can be stored on a high density 3½" diskette.

### Remote Operation

The 2635A Hydra Data Bucket has been designed for applications where data is gathered in a stand-alone manner "on location" and later uploaded to a PC for analysis and/or archiving. Three models of the Hydra Data Bucket are available with PC memory cards ranging in size from 256K, 1 Mb, and 2Mb in size. Up to 450,000 readings may be stored on a 2M byte memory card. For applications where large amounts of data are generated, you may swap memory cards without interrupting the Data Bucket's scanning.

The memory cards also store 2635A instrument configurations, enabling remote programming. For example, you could establish the desired Hydra configuration using Hydra Logger software package, load it onto a memory card, and then send it to the 2635A site, where it could be downloaded using a few front panel keystrokes. After completion of the data acquisition "run", the memory card would be returned for uploading the data into a PC.

Data Bucket is ideal for monitoring in mobile or remote applications such as weather stations, tank farms, or power substations, to verify that site equipment is set up and performing properly. All data can also be retrieved via modem, or you can request just the minimum, maximum, or last reading from each channel.

### Memory Card Drive

The Memory Card Drive provides an easy way to transfer your data from the Data Bucket's memory card to a PC. It may also be used to download your latest Data Bucket set-up to the memory card for later use in the field.

Housed in a compact, durable metal enclosure, the Memory Card Drive has robust data communication protocol to ensure accurate data transmission. An MS-DOS device driver allows the unit to work like a floppy disk. The Memory Card Drive supports cards from major manufacturers such as: Epson, Fujikura, Fujitsu, Maxell, and Mitsubishi. Just connect the reader to the parallel interface port of your PC, then use either Hydra Starter or Logger software packages to upload or download Hydra data or set-up files.

## Specifications

**Channel Capacity:** Analog Inputs: 21; Digital I/O & Alarm Outputs: 12 total; Totalizer: 1

**Power:** 90V ac to 264V ac (50 Hz or 60 Hz), or 9V dc to 16V dc; less than 10W. (If both sources are applied simultaneously, the greater of ac or dc is used. At 120V ac the equivalent dc voltage is ~14.5V)

**Temperature, Humidity** (non-condensing): Operating: 0 to 28°C, ≤90% RH; 28°C to 40°C, ≤75% RH; 40°C to 60°C, ≤50% RH; Storage: −40°C to 75°C, 5 to 95% RH

**Altitude:** Operating: 3050m (10,000 ft); Storage: 12,200m (40,000 ft)

**Common Mode and Normal Mode Voltage Maximum:** 300V dc or ac rms (channels 0,1,11); 150V dc or ac rms (all other channels)

**Isolation:** Analog input to analog input, and analog input to any digital input: meets IEC 1010 for 300/150 volts reinforced and ANSI/ISA-S82.01-1988 and CSA 231 for 250 volts single insulation

**Safety:** Complies with applicable sections of the IEC1010, ANSI/ISA-S82.01-1988, CSA231, UL 1244, and CSA 556B standards as noted above in Isolation

**RF Emissions:** Passes FCC EMI Class A Equipment and VDE 0871B

**Size:** 9.3 cm H × 21.59 cm W × 31.19 cm D (3.67 in H × 8.5 in W × 12.28 in D)

**Weight:** 2.95 kg (6.5 lb)

**Memory life:** 10 years typical for real-time clock, set-up configuration and measurement data in 2625A, memory cards typically 5 years for the 256 kB card.

### Measurement Accuracy

| DC Voltage | | | Accuracy[1] ± (% + V) | | |
|---|---|---|---|---|---|
| Range | Resolution | | Slow Scan | | Fast Scan |
| | Slow | Fast | 90 Days | 1 Year | 1 Year |
| 90 mV | 1 µV | 10 µV | 0.029% + 7 µV | 0.034% + 7 µV | 0.054% + 20 µV |
| 300 mV | 10 µV | 100 µV | 0.03% + 20 µV | 0.03% + 20 µV | 0.05% + 0.2 mV |
| 3V | 100 µV | 1 mV | 0.03% + 0.2 mV | 0.03% + 0.2 mV | 0.05% + 2 mV |
| 30V | 1 mV | 10 mV | 0.02% + 2 mV | 0.03% + 2 mV | 0.05% + 20 mV |
| 300/150V | 10 mV | 100 mV | 0.02% + 20 mV | 0.03% + 20 mV | 0.04% + 0.2V |

*90 mV Range on Data Bucket models

| Thermocouples[6] | | Accuracy[1,5] (±°C) | |
|---|---|---|---|
| | | Operate 18°C to 28°C | 0°C to 60°C |
| Type | Sensor Temperature (°C) | 90 Day Slow | 1 Year Slow |
| J | −100 to −30 | 0.46 | 0.56 |
| | −30 to 150 | 0.41 | 0.59 |
| | 150 to 760 | 0.51 | 0.92 |
| K | −100 to −25 | 0.54 | 0.65 |
| | −25 to 120 | 0.47 | 0.65 |
| | 120 to 1000 | 0.77 | 1.37 |
| | 1000 to 1372 | 1.19 | 2.06 |

**Interfaces:** RS-232C connector: nine pin male (DB-9P)

signals: TX, RX, DTR, GND
modem control: Full duplex
baud rate:* 300, 600, 1200, 2400, 4800, 9600, 19.2k**, 38.4**
data format: 8 data bits, no parity, one stop bit; or 7 data bits, one parity bit (odd or even), one stop bit
echo:* On/Off
flow control: XON/XOFF

* Set from front panel

** 2635A only

**IEEE-488 (Optional, 2620A Only):** Complies with IEEE-488.1 Standard; disables RS-232C Interface while in use

**2625A Data Storage:** Stores 2047 scans; stored with each scan: time stamp, all defined analog input channels, the status of four alarm outputs and eight digital I/O, and the totalizer count

**2635A Data Storage** (in scans) (same information as 2625A)

| Card Size | 4 ch | 10 ch | 20 ch |
|---|---|---|---|
| 256k | 8900 | 4800 | 2700 |
| 1M | 36500 | 19800 | 11200 |
| 2M | 74110 | 39910 | 22550 |

| RTD (Pt 100) | Resolution | Accuracy[1,4] (±°C) (4 wire) |
|---|---|---|
| Temp (°C) | Slow | Fast |
| −200 | 0.02 | 0.49 |
| 0 | 0.02 | 0.67 |
| 100 | 0.02 | 0.75 |
| 300 | 0.02 | 0.92 |
| 600 | 0.02 | 1.21 |

[1] Total instrument accuracy for 1 year following calibration (unless otherwise stated). Ambient operating temperature 18°C to 28°C. Includes A/D errors, linearization conformity, initial calibration error, isothermality errors, and reference junction conformity. (Sensor inaccuracies not included.) Relative humidity up to 90% non-condensing (except up to 70% for the 300kΩ, 3MΩ, and 10MΩ ranges).

[2] Sinewave inputs >2000 counts

[3] For two wire measurements on channels 1-20, add 1.5Ω to basic accuracy (does not include lead-wire resistances).

[4] DIN 385 only, assumes no lead wire resistance errors. Degrade accuracy for 2 wire sensors with $R_o$ = 100Ω by 5.0°C per lead-ohm, plus an additional 4°C for 2 wire measurements on channels 1 - 20.

[5] Resolution is 0.1°C or 0.1°F over the useful range of base metal thermocouples (J, K, T, E, N) and 0.2° resolution for types R, S, B, and C, with slow scan. Fast scan resolution = 1°C or F.

[6] Open thermocouple detection is performed on each thermocouple channel unless defeated by computer command.

| Frequency | | | |
|---|---|---|---|
| | Resolution | | Accuracy* |
| Range | Slow | Fast | ±(% + counts) |
| 15 Hz - 1kHz | 0.01 Hz | 0.1 Hz | 0.05% + 2 |
| 10 kHz | 0.1 Hz | 1.0 Hz | 0.05% + 1 |
| 100 kHz | 1 Hz | 10 Hz | 0.05% + 1 |
| 1000 kHz | 10 Hz | 100 Hz | 0.05% + 1 |
| 1 MHz | 100 Hz | 1 kHz | 0.05% + 1 |

| Sensitivity | |
|---|---|
| Frequency | Level |
| 15 Hz - 100 kHz | 100 mV rms sine wave |
| 100 kHz - 300 kHz | 150 mV rms sine wave |
| 300 kHz - 1 MHz | 2V rms sine wave |
| Above 1 MHz | not specified |

*Accuracy for both slow and fast scan speeds.

## 2620A/25A/35A Hydra Series

### Current Measurements

AC or DC current measurements may be accomplished using either a current shunt or external current probes. Using Mx+B scaling provides direct readings in amps. For lower current levels, shunts may be located in the input module. Suggested shunt values:

| Input | Shunt |
|---|---|
| 0 to 100 mA | 10 Ω* |
| 100 mA to 1A | 0.1 Ω |

For higher currents, the following current probes are recommended:

| | |
|---|---|
| 1A to 1000A dc | 80i-1010 Probe |
| 20A to 750A ac | 80i-1010 Probe |
| 20A to 400A ac/dc | 80i-410 Probe |

* 2620A-101 current shunts (12)

Alternatively, to measure 1.0 to 10.0A on Hydra's front panel input, use the 80J-10 Current Shunt

**Common Mode Rejection:** (slow scan) ac: ≥120 dB (50/60 Hz, ±0.1% max 1 kΩ source imbalance); dc: ≥120 dB

**Normal Mode Rejection:** (slow scan) 56 dB (50/60 Hz, ±0.1%)

**Temperature Coefficient:** <0.1 times applicable accuracy specification per °C for 0° to 18° and 28° to 60°C operation

**Scan Speed:** Slow: 4 rdg/sec nominal; fast: 17 rdg/second nominal, (1.5 rdg/sec for ACV and high Ω inputs nominal)

**Analog to Digital Converter:** Dual slope type, linear to 16 bits

### Totalizing Input

DC-coupled, non-isolated, max +30V, −4V

**Max Count:** 65,535

**Minimum Signal:** 2V peak

**Threshold:** 1.4V

**Hysteresis:** 500 mV

**Rate:** 0-5 kHz (debounce off)

**Input Debouncing:** None or 1.66 ms

### Digital Inputs

**Threshold:** 1.4V

**Hysteresis:** 500 mV

**Maximum Input:** +30V, −4V, non-Isolated

### Digital Alarm Output

The output lines are non-isolated, TTL compatible with the following logic levels (driving the equivalent of 1 LSTTL load):

Logical "zero" output:
0.8V max, ($I_{out}$ = −1.0 mA)
Logical "one" output:
3.8V min, ($I_{out}$ = 0.05 mA)
For non-TTL loads, the outputs are as follows:
Logical "zero" output:
1.8V max, ($I_{out}$ = −20 mA)
3.25V max, ($I_{out}$ = −50 mA)

### Trigger Input

**Minimum Pulse:** 5 µs

**Maximum Latency:** 100 ms

**Repeatability:** 1 ms

**Input "High":** 2.0V min, 7.0V max

**Input "Low":** −0.6V min, 0.8V max, non-isolated, contact closure and TTL compatible

**Clock/Calendar:** Accurate to within 1 minute/month at 25°C

## Ordering Information

### Models

**2620A** Hydra Data Acquisition Unit *$2395*

**2620A/05** Hydra Data Acquisition Unit w/IEEE-488 Interface *$2750*

**2625A** Hydra Data Logger *$3150*

**2635A** Hydra Data Bucket *$3550*

**2635A-1MB** Data Bucket w/1mb Card *$3750*

**2635A-2MB** Data Bucket w/2mb Card *$3950*

### Included with Instrument

One-year product warranty, line cord, Universal Input Module, Hydra Starter Software Package, 256K memory (2635A only), T thermocouple, and operator's manual.

### Options

**2620A-100** Extra I/O Connector Set: includes Universal Input Module, Digital I/O and Alarm Output Connectors *$195*

**2620A-05K** IEEE-488 Interface Kit (2620A only) *$355*

**263XA-802*** External Disk Drive

**263XA-803** Memory Card Drive *$390*

**263XA-804** 256 KB Memory Card *$175*

**263XA-805** 1 MB Memory Card *$395*

**263XA-806** 2 MB Memory Card *$595*

**26XXA-600** Portable Battery Pack *$195*

**2620A-101** 4-20 mA current shunt strip (12) *$50*

### Application Software

**262XA-901** Hydra Data Logger Package (DOS) *$390*

**26X5A-901** Hydra Logger for Windows *$595*

**26X5A-902** Hydra Logger for Windows with Trending *$995*

**26XXA-904** Trend Link for Fluke *$895*

**262XA-910*** ScanScape Software Package for Windows 3.X

*Available in European countries only

### Accessories

**RS40** RS-232C to Terminal Cable: Connects to PC/XT, PS/2 *$30*

**RS41** RS-232C to Modem Cable (Join w/RS40 to connect to PC/AT) *$30*

**RS42** RS-232C to Serial Printer Cable/ RS43: RS-232C DB9 to DB9 for P.C. to Hydra *$35*

**RS43** RS-232C DB9 to DB9 for P.C. to Hydra 6′ *$45*

**80i-410** Clamp-on DC/AC Current Probe *$179*

**80i-1010** Clamp-on DC/AC Current Probe *$297*

**80J-10** Current Shunt *$65*

**C40** Carrying Case *$50*

**M00-200-634** Rack Mount Kit *$122*

**Y8021** Shielded IEEE-488 Cable, 1m *$195*

**Y8022** Shielded IEEE-488 Cable, 2m *$210*

**Y8023** Shielded IEEE-488 Cable, 4m *$220*

### Manuals

**2620A/2625A** Service *$159*

**2620A/2625A** Hydra Logger *$23*

**2620A/2625A** User *$30*

* No charge with purchase of unit

### Customer Support Services

### Factory Warranty

One-year product warranty.

# Data Acquisition Tools

## Fluke Wireless Logger

Transmit real time data up to ¼ mile (402m) away without wires

Avoid the high cost of wiring

System supports up to 20 Wireless Logger satellites

20 analog input channels expandable up to 400 channels

Microsoft windows based application software

Extensive optional plotting and trending capabilities

2625A/WL

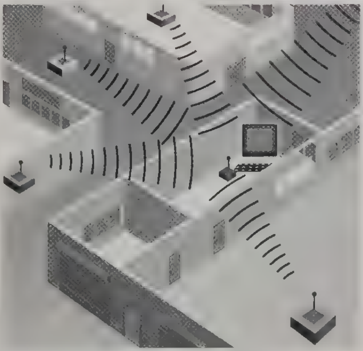
### Signaling a New Era in Data Acquisition

The 2625A/WL Wireless Logger is a new class of data acquisition tool that uses a highly noise immune radio transmission technique, instead of wire and cables, to transmit real time data to a host computer up to ¼ mile away! The new Wireless Logger gives you the freedom to setup and operate on a moment's notice, anywhere, anytime without dealing with expensive and inconvenient wiring to a host PC. Each Wireless logger can accommodate up to 21 analog inputs of any type and up to 20 Wireless Loggers can operate from one base station PC, giving you expandable, wireless operation. The 2625A/WL is ideally suited for real time, PC-based data acquisition applications where quick, convenient setup in difficult or hostile areas is important.

### Spread Spectrum

The key to the Wireless Logger system is its use of spread spectrum radio transmission, a highly noise immune form of communication. Spread spectrum technology was originally developed for the military to provide secure, non-jammable communications for intelligence, command, and tactical groups as well as guidance and delivery systems. The 2625A/WL Fluke Wireless Logger uses this same technology to reliably send data directly to your PC with a high degree of immunity to electrical noise and interference. Almost impervious to RF interference the 2625A/WL is well suited for real time data collection from remote or otherwise difficult-to-access areas.

Spread spectrum technology allows the wireless Logger to transmit successfully in electrically noisy areas where narrow band transmitting equipment, and even some hard-wired systems fail. This means that motors, solenoids, walkie-talkies, induction heaters and other sources of severe electrical interference have almost zero chance of interrupting your data. Another benefit of the Wireless Logger is its ability to coexist with other electronic equipment. Its low 500 mW power output is lower than many cellular phones. The spread spectrum modulation technique spreads a small signal over a wide bandwidth and peak power at any frequency is around 30 db lower than an equivalent narrow band transmission. This lower energy content of the spread spectrum signal means it won't disrupt or interfere with other electronic instrumentation. Because the Wireless Logger's output is less than one watt and it uses non-intrusive spread spectrum signals, it complies with FCC part 15C and does not require an FCC site license.



Now you can have multiple satellites transmitting data to a central PC from various locations throughout your plant without incurring wiring installation costs.

### Wireless Logger System

The Wireless Logger system may consist of up to twenty (20) Wireless Loggers (2625A/WL), communicating to one (1) Wireless Base station (26X5A/WL-700). Each base station includes Wireless Logger for Windows application software and a wireless base station modem. The familiar windows format of Wireless Logger for Windows makes initial instrument setup, data collection, creating real time trend graphs and other data acquisition tasks easy and intuitive from your PC.

### Wireless Logger (2625A/WL)

The light weight and portable Wireless Logger data acquisition tool is easy to setup and operate. The 2625A/WL is flexible, rugged and accurate and has all the outstanding features and specifications of the Hydra 2625A (see page 195 for 2625A specifications). Simply connect your inputs to the universal input connector on the wireless logger, run Wireless Logger for Windows application software on your PC, and you are operating in real time, remotely, with no wiring obstacles to overcome and no external signal conditioning to hook up.

### Wireless Logger for Windows

Wireless Logger for Windows is a true windows based data acquisition software package specifically for use with the 2625A/WL Wireless Logger. Wireless Logger for Windows supports scanning, channel definition, trend graph analysis, and alarm configurations for up to 20 Wireless Loggers in one host PC. The familiar Windows based format of Wireless Logger for Windows makes data collection and instrument setup an easy, intuitive task. In addition to its trend graph display,

# Data Acquisition Tools

## Fluke Wireless Logger

Wireless Logger for Windows also allows the user to port data in real time, directly to other programs such as Trend Link for Fluke, Lotus 1,2,3, and Excel by using a DDE (Dynamic Data Exchange) link.

Its real time data display provides trend plots as events are occurring. And you can transfer data between programs for report generation. Wireless Logger for Windows will also support a 2625A or 2635A connected to a PC's RS-232C port in addition to communicating to Wireless Logger Satellites.

With Windows multi-tasking, you can be working with a word processor in one window, a spreadsheet in another and monitoring your Wireless Logger in another. You can also set an alarm to alert you to pre-determined events regardless of which program you're in.

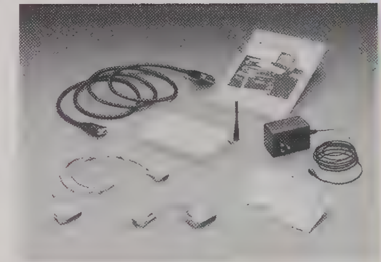
### Fault Tolerant

Wireless Logger stores over 2000 scans in its non-volatile buffer. That's especially important if you're performing a test that's difficult or expensive to reproduce.

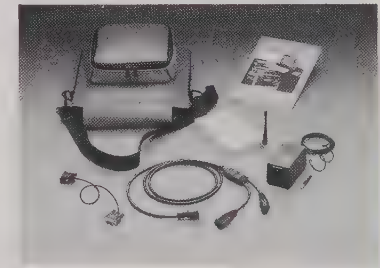
If, for any reason, your PC goes down or needs to be re-booted, Wireless Logger satellites will continue to collect measurements and store over 2000 scans in each satellite. When your PC comes back on line, your data will be transferred to your data file, automatically, thus saving you from frustration as well as extra time and expense due to loss of data.

### Applications

Typical applications for the Wireless Logger include process improvement diagnostics, preventative maintenance profiling, new product testing, laboratory tests, vehicle testing and other applications where fast and immediate setup and real time monitoring are required.



2625A/WL-700



26X5A/WL-701

The Wireless Logger excels in applications where immediate information is needed to verify a process or situation. Plant engineering and maintenance, process industries, power generation, and vehicle testing are just a few representative areas where applications for the Wireless Logger and Wireless Logger for Windows package can cut otherwise large cumbersome jobs into small ones. The Wireless Loggers ability to transmit through barriers such as walls and floors and to transmit up to 800 feet indoors and ¼ mile in line-of-sight applications is key to getting your data when and where you want it.

## Ordering Information

### Model

**2625A/WL*** Fluke Wireless Logger ***$3995***

**2625A/UL-700** Wireless Base Package: includes Wireless Modem, Wireless Logger for Windows S/W Package, Hydra Wireless Logger, User Manual, RS40 Cable, DB25 to DB9 Adapter ***$1995***

### Included with Instrument

2625A Hydra Data Logger, Wireless Modem, Getting Started Manual, Soft Carrying Case for the Wireless Logger, Wireless Logger Power Kit.

### Options

**26X5A/WL-701** Hydra Wireless Conversion Kit; for converting models 2625A or 2635A to a Wireless Logger: includes Wireless Modem, Soft Carrying Case for the Wireless Logger, Getting Started Manual, Wireless Logger Power Kit ***$1190***

**26X5A/WL-702** Wireless Modem ***$990***

**26X5A/WL-703** Wireless Logger Power Kit: includes Power Module, Receptacle Power Cable, Short RS-232C Cable ***$150***

**26X5A/WL-705** Wireless Logger Battery Power Kit with Charger ***$250***

**26X5A/WL-902** Wireless Logger for Windows S/W Package, Windows-based Software Program, Wireless How To Manual ***$995***

**2620A-100** Extra I/O Connector Set: includes Universal Input Module, Digital I/O and Alarm Output Connectors ***$195***

**2620A-101** 4-20 mA current shunts; Qty 12 ***$50***

### Accessories

**C42** Wireless Logger Soft Carrying Case ***$60***

**PV350** Pressure/Vacuum Transducer Module ***$269***

**80i-410** Clamp-on DC/AC Current Probe ***$179***

**80i-1010** Clamp-on DC/AC Current Probe ***$297***

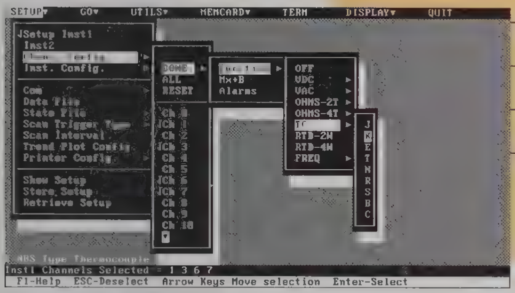
**80J-10** Current Shunt ***$65***

*The Wireless Logger is not available in all countries

# Data Acquisition Tools

## Hydra Logger (DOS) Software

- Supports all the Hydra models–2620A, 2625A, 2635A
- Supports 20 channels–two Hydra instruments
- Supports both RS-232 and IEEE-488
- Displays and graphs up to eight channels
- Trend playback
- Multiple language versions



Inst1 Channels Selected = 1 3 6 7

F1-Help ESC-Deselect Arrow Keys Move selection Enter-Select

Hydra Logger simplifies setup with easy-to-use menus.

### Hydra Logger (DOS) Software Package

Hydra Logger (DOS) allows you to set up channels and functions on Hydra quickly and easily on your PC. All functions are controlled via simple menus using either the keyboard or mouse. Hydra Logger gives you control of virtually all of Hydra's functions, including: scanning, signal conditioning, sensor linearization, alarm detection and reporting, non-volatile data memory, and much, much more!

The Hydra Logger Software Package combines with a Hydra instrument and your PC to create a powerful data acquisition system. "Logger" supports all Hydra models: 2620A, 2625A, and 2635A.

### No Programming:

Hydra Logger provides easy-to-use "pull-down" menus, check boxes and radio buttons to make configuring your data acquisition system a breeze. Menu selections are made using your keyboard or mouse. Context-sensitive help is always available to provide just the information you need – immediately!

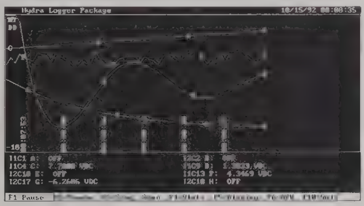
### Easy Menu-Based Configuration:

Configuring channels individually or in blocks is simple. Hydra Logger allows you to select the channel(s) to be configured, then choose from a list of all input types and you're done. Apply Mx+B scaling and alarms to each channel or blocks of channels as you wish. You can then choose one of the channels to be "monitored" on Hydra's front panel. This monitor channel may be changed at any time to view any defined parameter.

Menu programming also allows you to specify continuous or interval scanning of all defined inputs. Intervals may be specified from 1 second to 10 hours. Scan trigger source may be set to external input or monitor channel alarm conditions. The PC data display and trend graph is updated with each scan. Data may be recorded to a file with every scan or every nth scan.

### Access to Data Bucket Features:

Hydra Logger gives you quick and easy access to Data Bucket memory card features. Logger can copy files from a Data Bucket memory card to a PC, format a memory card, delete memory card files, and more. Logger can even store Data Bucket configuration information on the memory card, so that the Data Bucket can be set up in the field be a less technical user and begin logging data with the press of a button.



I1C1 A: OFF
I1C4 C: 7.7000 VDC
I2C10 E: OFF
I2C17 G: -6.2605 VDC
I2C2 B: OFF
I1C9 D: 1.3823 VDC
I1C13 F: 4.3469 VDC
I2C10 H: OFF

Display of data in text and trend graphics makes it easy to monitor.

### Display and Trend Graph:

Hydra Logger displays data in real time. Choose either a color trend graph with current data of up to 8 channels, or a tabular display of the current data from all 21 channels (42 with two Hydras). Data that is in "Alarm" state is tagged ALM and the data is shown in red on color monitors and highlighted on monochrome monitors. You can also set an alarm bell on the PC as an audible reminder when alarm limits have been exceeded.

### Trend Playback:

Data that has been stored in a data file can be played back on a trend plot similar to the on-line data collection display.

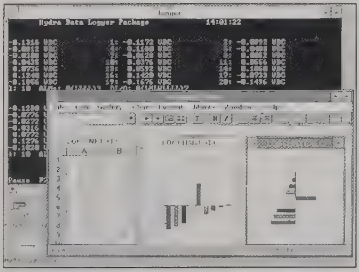
### Printer Operation:

With Hydra Logger, you can print measurement data on your PC printer in a tabular alphanumeric format. Or, if your printer supports Epson® compatible graphics, then trends of channel data (from 1 to 42 channels) may be printed emulating a strip chart output.

### Automatic Data Collection:

To record data as it is being measured, the "Data File" menu selection prompts for file name and the number of scans to skip between data recordings. Skipping one or more scans allows the display to update often without recording more data than is required. This allows you to check for alarms, update the display, and plot trends on the printer without wasting memory.

Data may be recorded in ASCII format for readability or binary format for compactness. When an existing file is chosen for recording, you may append new data or overwrite the old data, whichever meets your needs. RS-232 or IEEE-488, choose the interface that best fits your needs. Hydra Logger supports up to two Hydra instruments at one time via either COM ports (RS-232) or an IEEE-488 interface (compatible with National Instruments NI-488 MS-DOS Software).



Hydra Logger exchanges data with spreadsheet via. csu files.

### Data Logging Utility Functions

#### Conversion routines

transform your data files to standard "DIF" or ASCII formats so that data is easily available to your favorite analysis, graphics and word processor software.

# Hydra Logger (DOS) Software

**Access to DOS**
allows you to execute DOS commands from within the Hydra Logger environment.

**Upload Memory Card Data**
from the Hydra 2635A Data Bucket memory cards. By storing Data Bucket configuration information on a memory card, a Data Bucket can be taken to the field by a less technical user and data logging can begin by a simple press of a button. When the test has been completed or the memory card is full, the memory card may be removed and transported back to the PC for analysis or archival.

**Upload Data Memory**
from the Hydra 2625A Data Logger. The 2625A's non-volatile memory stores measurement data along with time of acquisition, channel numbers and units. After a test has been completed, the 2625A may be turned off and transported back to the PC for data uploading.

**A Terminal Emulator**
is also included with Hydra Logger allowing direct access to Hydra via the selected communications interface. In terminal emulation mode, you type Hydra commands on the PC keyboard. This is especially useful for verifying communications and to check sensor integrity.

**The Pruning and Grafting Utility**
included with Hydra Logger allows users to combine or prune data files as required. With the Data Bucket's ability to collect large volumes of data on memory cards, you may collect more data than you really need. Large volumes of data are very difficult to handle and examine in PC spreadsheet programs or with other analysis tools. Logger's pruning and grafting utility can save you time, by allowing you to extract critical data from large memory card data files. Or, if you wish to combine data from multiple memory cards into a single file, the pruning and grafting utility makes it simple.
Models Supported: 2620A, 2620A/05, 2625A, 2635A

### System Requirements

- Personal Computer: XT, AT or 386 class
- Serial Interface configured as "COM1:" or "COM2:" or IEEE-488 Interface National Instruments PC-11 or National Instruments AT-GPIB

Cables: Fluke RS43 recommended to connect Hydra to a PC

### Hydra Series Software Comparison Chart

| | **Hydra Starter** (Included free with every Hydra) | **Hydra Logger for Windows®** 26X5A-901 & 26X5A-902 | **Hydra Logger** (DOS-based) 262XA-901 | **Wireless Logger for Windows** 26X5A/WL-901 |
|---|---|---|---|---|
| **Windows®-based product** | No | Yes | No | Yes |
| **DOS-based product** | Yes | No | Yes | No |
| **Trending Support** | No | Yes | No | Yes, Via DDE |
| **Modem Support** | No | No | Yes | No |
| **Wireless Logger Support** | No | No | No | Yes |
| **2620A and 2620A/05 Support** | Yes | No | Yes | No |
| **2625A and 2635A Support** | Yes | Yes | Yes | Yes |
| **2635A Memory Card Support** | Yes | Yes | Yes | No |
| **Number of Instruments Supported** | 1 | 2 | 2 | 20 |
| **Help Files and Manual Language Support** | Complete<br>English | Complete<br>English<br>German<br>French<br>Spanish | Complete<br>English<br>German<br>French | Complete<br>English |
| **World-Wide Product** | Yes | Yes | Yes | US and Selected Countries |

## Ordering Information

### Models

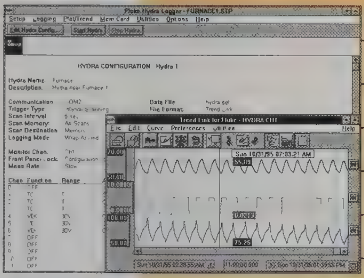
**26XXA-901** Hydra Logger (DOS) Software Package ***$390***
**RS40** RS-232C Cable (to terminal or PC/XT or a 25 pin connector) ***$30***
**RS41** RS-232C Cable (to modem) ***$30***
**RS43** RS-232C Cable (to a PC/AT or a 9 pin connector) ***$45***
**Y8021** IEEE-488 Cable (1 meter) ***$195***
**26XXA-901d** Hydra Logger, German version ***$390***
**26XXA-901f** Hydra Logger, French version ***$390***

Ask for a free demo disk.
Hydra Logger simplifies setup with easy-to-use menus.
Hydra Logger exchanges data with spreadsheet via .csu files.
Display of data in text and trend graphics makes it easy to monitor.

# Data Acquisition Tools

## Hydra Logger for Windows® Software

- True Microsoft Windows package
- Supports the 2625A and 2635A Hydra models
- Supports 40 channels–two Hydra instruments
- Extensive optional plotting and trending capabilities
- Full DDE (Dynamic Data Exchange)
- Multiple language support (English, German, French and Spanish)
- Intuitive interface
- On-line help


Fluke Hydra Logger - FURNACE1.STP
HYDRA CONFIGURATION Hydra 1
Trend Link for Fluke - HYDRA.CHT

The Hydra Logger for Windows software package gives you a powerful data acquisition system when combined with a Hydra instrument and your PC. Hydra Logger gives you control of Hydra's powerful functions, including scanning, signal conditioning, sensor linearization, alarm detection and reporting, non-volatile data memory, advanced trend plotting and more. "Logger" supports the 2625A and 2635A Hydra models.

### Advanced Trending Capabilities:

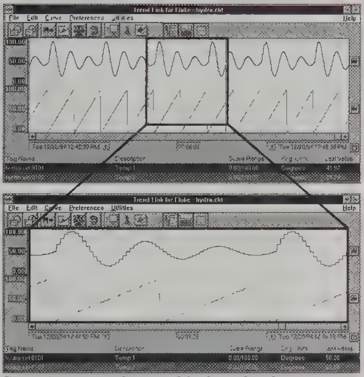
With Hydra Logger's optional, comprehensive trend plotting package, you control how your data is displayed. You can quickly scroll through real time and historical data, or view data from all channels simultaneously, on a single screen. Or, you can plot one or multiple channels in real time, even superimposing channels on other channels. Record comments for future reference by simply tagging notes to any point on a curve, which becomes a permanent part of the data file.

### Easy Access to Basic Statistics:

Hydra Logger's optional trend plotting package also calculates basic statistics such as mean and standard deviation. It will also create X-bar R charts and X-Y scatter diagrams (e.g. plot temperature vs. relative humidity, or frequency vs. voltage). For more extensive data analysis, import your data into a spreadsheet like Lotus® 1-2-3® or Microsoft® Excel.™ If the data file is too big for your spreadsheet, simply zoom into and isolate the data you want, and export only that portion to your spreadsheet.

### No programming:

Hydra Logger for Windows allows you to set up channels and functions on Hydra quickly and easily on your PC with Microsoft Window's highly intuitive user interface. Easy-to-use dialog boxes make configuring your data acquisition system a breeze. Menu selections are made using your mouse or keyboard. Context-sensitive help is always available to provide just the information you need – immediately!


Trend Link for Fluke - hydra.cht
File Edit Curve Preferences Utilities Help

Zoom into your data and isolate the data so you can get right down to making decisions.

### Easy Menu-Based Configuration:

Configuring channels individually or in blocks is simple. With Hydra Logger, simply select the channel(s) to be configured, make selections from a list of all input types and you're done. Apply Mx+B scaling and alarms to each channel or blocks of channels as you wish. Then choose one of the channels to be "monitored" on Hydra's front panel. This monitor channel may be changed at any time to view any defined parameter. Menu programming also allows you to specify continuous or interval scanning of all defined inputs. Intervals may be specified from 1 second to 10 hours. Or, initiate scanning based on an external trigger signal or on an analog input that exceeds alarm limits. Record data to a file with every scan or every nth scan.

### With the 2635A Data Bucket,

Hydra Logger provides quick and easy access to Data Bucket memory cards. By storing Data Bucket configuration information on a memory card, a Data Bucket can be taken to the field and data logging can begin immediately with a simple press of a button. When the test has been completed or the memory card is full, the memory card may be removed and transported back to the PC for analysis or archival.

### With the 2625A Data Logger,

Hydra Logger acts as a remote host through which stored data can be periodically uploaded. The 2625A's non-volatile memory stores measurement data along with time of acquisition, channel numbers and units. After a test has been completed, the 2625A may be turned off and transported back to the PC for data uploading. Logger makes it easy to display data or store it in a file format that is compatible with your favorite data analysis and graphics package, such as Excel, Lotus 1-2-3 or InTouch Wonderware.

### RS-232:

Hydra Logger supports up to two Hydra mainframes (either 2625A or 2635A) at one time via either COM1 and/or COM2. Models Supported: 2625A, 2635A.

### System Requirements

- System: IBM PC compatible with an Intel 386 microprocessor or greater (486 recommended when running with trending)
- Hard Disk Drive: with 4 MB of free space
- Floppy Disk Drive: 1.44 MB (3.5") floppy disk drive
- Memory: with at least 4 MB RAM
- Monitor: Any monitor supported by Windows (color recommended)
- Operating System: Microsoft Windows version 3.1 or later
- RS-232 Cable: Fluke RS43 required to connect Hydra to a PC

## Ordering Information

### Models

**26X5A-901** Hydra Logger for Windows *$595*

**26X5A-902** Hydra Logger for Windows with Trending *$995*

**26XXA-904** Trend Link for Fluke (Trending Support for Hydra Logger for Windows) *$895*

**RS43** RS-232 Cable *$45*

Ask for a free demo disk.

# Data Acquisition Tools

## Trend Link for Fluke

A comprehensive trend plotting and analysis package

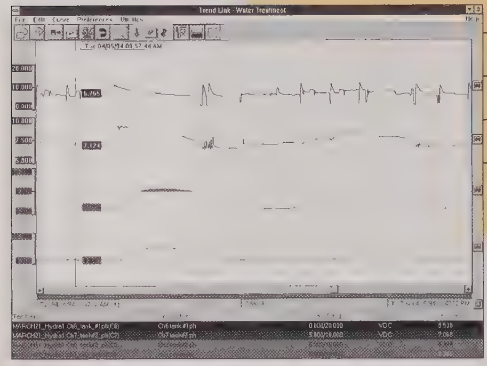
Access, view, and analyze tremendous amounts of historical and real time data

Zoom in on points of interest in your data

Calculate basic statistics such as mean and standard deviation

Attach notes to any point on a trace

Trend Link supports NetDAQ Data Acquisition tools, the Hydra Series, the Wireless Logger™ and the Helios family.


Trend Link - Water Treatment
File Edit Curve Preferences Utilities Help
Tue 04/05/94 08:57:44 AM
20.000
10.000
10.000
7.500
5.000
6.765
7.124
MARCH21_Hydra1:Ch6_tank_#1ph(C6)
MARCH21_Hydra1:Ch7_tank#2_ph(C7)

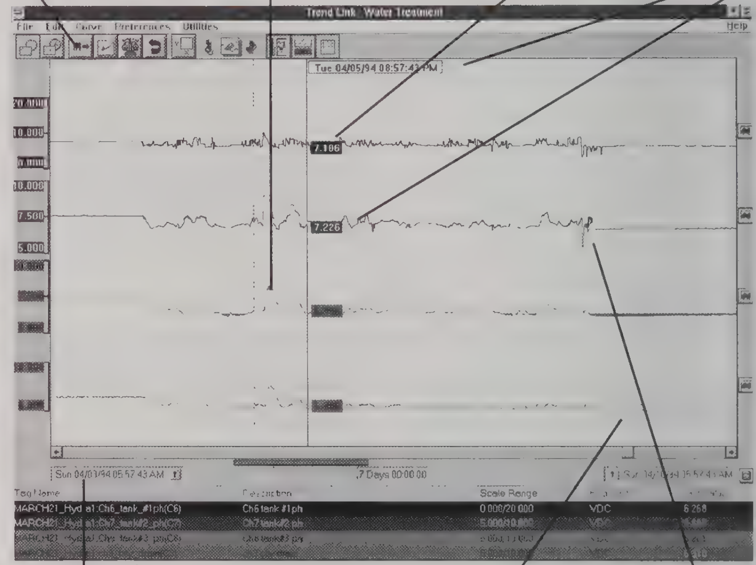
Zoom in on points of interest

Control bar provides fast, easy access to basic chart functions

Alarm shading gives visual indication of alarm point violation

Main cursor bar under mouse control

Displays value and time at main cursor intersection


Trend Link - Water Treatment
File Edit Curve Preferences Utilities Help
Tue 04/05/94 08:57:43 PM
20.000
10.000
10.000
7.500
5.000
7.106
7.226
Sun 04/03/94 05:57:43 AM
7 Days 00:00:00
Tag Name
Description
Scale Range
MARCH21_Hydra1:Ch6_tank_#1ph(C6)
Ch6 tank #1ph
0.000/20.000
VDC
6.268

Scroll through history

Status bars offer detailed curve information

Statistical process control function generates upper/lower control limits

Notation system attaches your comments as a permanent part of the record

Trend Link for Fluke is a comprehensive trend plotting and analysis software package for Fluke's line of data acquisition equipment: the NetDAQ High Speed Data Acquisition Family, the Hydra Family, the Wireless Logger, and the Helios Family of Data Acquisition Front-Ends. Trend Link's intuitive Microsoft Windows-based interface allows the user to access, view, and analyze tremendous amounts of historical and real time data on a PC. Users can view data from all their analog measurement channels simultaneously, on a single screen, and plot one or multiple channels in real time – even superimposing channel plots on one another.

### Trend Data

Trend Link time stamps data with millisecond resolution so you can find just the data you're looking for. The dead banding feature lets you record only readings outside of the range of your normal process limits, saving you valuable disk space.

### File Rollover

File rollover lets you manage the data file size, an especially useful feature when you're collecting data for long periods of time. You can create new data files when the file reaches a certain size, at a specific time interval, or at a specified hour each day.

### Interfacing With Other Software Packages

Trend Link for Fluke accepts data from the following Windows-based software packages:

- Hydra Logger for Windows
- NetDAQ Logger for Windows
- Wireless Logger for Windows
- Helios Logger (DOS)
- Microsoft Excel
- Lotus 1-2-3
- Quatro Pro

### Supported Data Acquisition Equipment

Trend Link for Fluke works with your PC and Fluke's full line of data acquisition equipment including:

- 2640A and 2645A NetDAQ High Speed Data Acquisition Tools
- 2625A Hydra Data Logger
- 2635A Hydra Data Bucket
- 2625A/WL Wireless Logger
- 2287A Helios Plus Mainframe
- 2289A Helios-I Mainframe

System Requirements

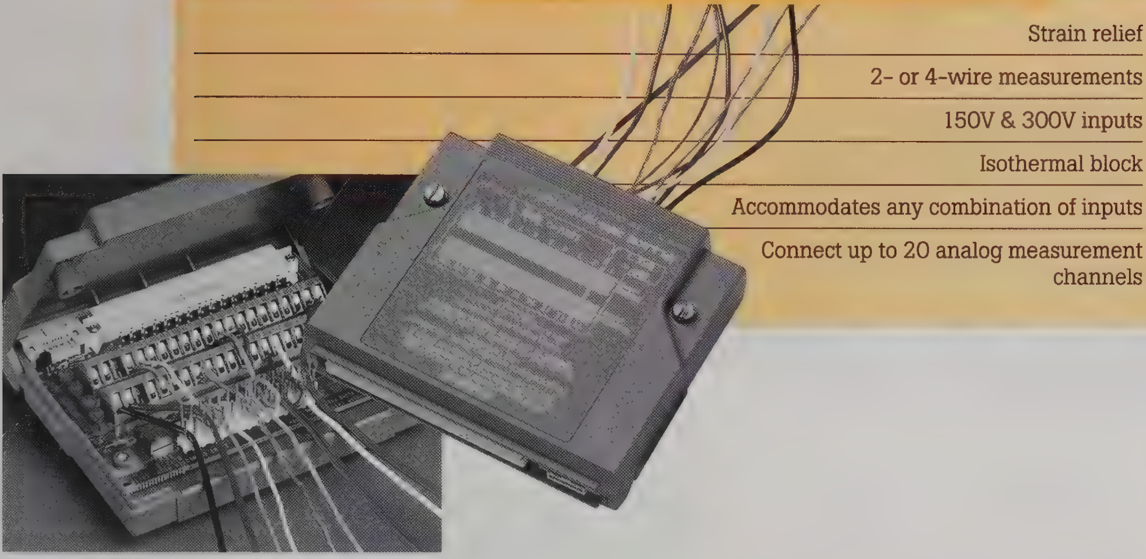
- System: IBM PC compatible with an Intel 386 microprocessor or greater (486 recommended)
- Hard Disk Drive: with 5 MB of free space
- Floppy Disk Drive: 1.44 MB (3.5") floppy disk drive
- Memory: with at least 4 MB RAM
- Monitor: Any monitor supported by Windows, (color recommended)
- Operating System: Microsoft Windows version 3.1 or later

## Ordering Information

**26XXA-904** Trend Link for Fluke *$895*

# Data Acquisition

## Universal Input Module


Strain relief
2- or 4-wire measurements
150V & 300V inputs
Isothermal block
Accommodates any combination of inputs
Connect up to 20 analog measurement channels

The Universal Input Module lets you easily measure just about any electrical or physical parameter without changing hardware or adding external signal conditioners. It's like having a box full of signal conditioners in one palm-sized package.

Fluke's Universal Input Module accommodates 20 analog input channels–any combination of DC voltage, AC voltage, thermocouples, current, RTD, resistance (2- or 4-wire) or frequency. With MbX scaling you can convert a wide range of signals (0-10V or 4-20 mA) into standard engineering units.

Thermocouple reference junction compensation occurs automatically by sensing the temperature of the input module's isothermal block, which contributes less than 0.02°C of error. Excellent isothermal performance is achieved by thick copper layers embedded just beneath the connection points and an enclosure which protects inputs from changing environmental conditions. Strain relief protects sensor wires from accidental disconnection.

For calibration or for use in another application, you can leave your field connections set up at your site and merely plug in and unplug the Universal Input Module when you want to move your Fluke data acquisition tool.

Measure the following inputs with the Universal Input Module:

- Thermocouples (J, K, N, E, T, R, S, B, C)
- ACV
- DCV
- Frequency
- RTDs (PT100s)
- Resistance
- 4-20 mA

### 4-20 mA Current Shunt Strip Set

The Current Shunt Strip Set plugs into a Universal Input Module and allows current to be directly measured. Each set of strips supplies 12 current shunts: 3 strips each with 3 current shunts and 3 strips each with 1 current shunt.

There are two measurement ranges you can pick with the current shunt strip: 4-20 mA DC or 0-100 mA DC.

## Ordering Information

### Models

**2620A-100** Universal Input Module ***$195***
**2620A-101** 4-20 mA Current Shunt Strip Set ***$50***

# Data Acquisition Tools

## Helios Series Data Acquisition Front Ends

Monitor and document processes, design tests, quality assurance

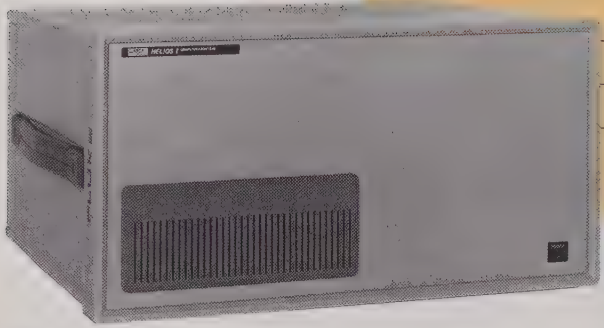
Built-in signal conditioning handles a wide range of input types

High accuracy measurements – up to 1000 per second

Flexibly accommodates 20 to 1500 inputs

Choice of PC software options to suit your application

Ruggedized dc powered version for mobile applications



Helios I

The Helios Data Acquisition system is a high performance yet economical solution to medium and larger scale data acquisition applications. Its high accuracy measurement capabilities can be extended from 20 to 1500 analog or digital input points, handling nearly any input type from thermocouples to strain gages. All signal conditioning and isolation is built-in, eliminating the need for expensive external signal conditioners. Helios' distributed architecture enables larger systems to be installed in a 1km radius, putting the measurement hardware near the sensors & transmitters, in turn reducing cabling/wiring costs and increasing measurement integrity.

A selection of PC based software provides flexibility – choose either a package which configures and runs Helios through a selection of menu choices, or choose to write your own custom software package with the assistance of Helios Toolbox utilities.

### Two Helios Models

**Helios-I**

This standard Helios mainframe accommodates all Helios measurement options (except the -165 high speed A/D) and is expandable to 1500 inputs. Its high accuracy (17 bit) measurement system is ideally suited to temperature, flow, pressure, and static strain-based applications. Helios-I converts all inputs into engineering units for displaying, recording and archival purposes.

**Helios Plus**

The Helios Plus offers all the features of Helios-I and adds:

- **Faster measurement speed** – up to 1000 measurements per second in Burst mode. Burst mode stores a pre-defined amount of pre-trigger and post-trigger data – up to 78,000 readings with the -265 memory expansion module.
- **Autonomous scanning** – self-initiates scans on time interval time stamps and stores more than 35,000 readings (battery-backed memory) for later computer retrieval
- **Alarm response and output** – Helios Plus compares each reading against as many as four limit levels and can take action on out of tolerance conditions with its master alarm output or digital output options.
- **Local printer support** – a special port makes data available a local printer when Helios Plus is located at a remote site or the host computer is not available, such as when being accessed by modem.

### A Wide Range of Measurements

**Choose your sensor type.** Thermocouples, RTDs, strain gages, pressure, flow, contact closure, frequency, voltage, current, speed, or resistance. The modular architecture of Helios lets you configure your system with all the sensors you want without paying extra for the ones you don't want. It also provides user-defined tables for unusual sensors.

The conversion routines resident in Helios makes your system cost-effective and efficient. Because you do not have to develop routines for engineering units conversions, software development is reduced, saving you both time and money. And with Helios to take care of those tasks, the host computer is free to do other tasks, improving the system's real-time performance.

**Choose accuracy:** You can add the -161 High Accuracy A/D option to Helios-I or Helios Plus, for extreme accuracy and high isolation in low-level measurements. This is especially important when making thermocouple measurements where high common-mode voltages are present.

**Choose speed:** With Helios Plus, the -165 Fast A/D option makes measurements at 1000 readings per second in burst mode and 70 readings per second continuous throughput. The overall accuracy of the -165 is unmatched by comparable instruments operating at these speeds. With Helios Plus, you can combine the -165 with the -161 High Accuracy A/D, to give you precise measurements and fast measurements in a single instrument.

### Enhance System Performance with Helios Plus (2287A)

For higher performance or remote data acquisition systems, consider the benefits of Helios Plus.

**Higher continuous throughput.** Each 2287A-165 normally provides readings to the host computer at continuous throughput of up to 70 readings per second.

Burst Mode samples inputs at 1000 readings per second. With the external triggering capability, several 2287A-165 A/D Converters will freeze their data buffers for multiple measurement snapshots. To get just the data you need you specify the amount of pre- and post-trigger data to be captured on each A/D. With the addition of a 2287A-265 Memory Expansion Option, each A/D can store up to 79,500 readings for later retrieval.

**Automatic sensor scanning, data buffering and alarm detection** make Helios Plus ideal for applications that require more local intelligence. With this added intelligence your host computer will have more time for operator interaction, data analysis, and report generation. Helios Plus can schedule its own measurement scans, buffer data, and check for alarms. Since memory is battery-backed, you can be sure that Helios Plus will save your latest readings.

### Remote/Mobile Data Acquisition Applications

The rugged design of Helios Plus combined with the intelligence to automatically take measurements, check for alarms, buffer data, then provide them on request, makes it ideally suited for remote-site data acquisition. Measurement data may be sent to the local printer port, providing data to on-site operators.

**Optional dc powered Helios.** The 2287A/AA and 2289A/AA are designed for mobile testing and remote data gathering at sites that lack line power. Both are powered from either a 12V dc or 24V dc supply (8-18 or 21-28V dc respectively) and have an extended operating range to +70°C.

## Helios Series I/O Options

Helios Series mainframes and extender chassis use a "card cage" architecture that provides superior flexibility because both channel count and channel type are easily adjusted to match your application needs. If a new I/O type is needed, simply install the appropriate option in the next open slot. Configuration and control of these options is easy using any of the available software packages.

The "card cage" architecture provides six slots per mainframe or extender chassis for I/O options. When analog input options are included, one of the six slots must contain an A-to-D converter (2289A-161 or 2287A-165). The high accuracy A-to-D converter (2289A-161) controls one to five 20 channel "scanner" options for up to 100 channels per mainframe or extender chassis. Each fast A-to-D converter (2287A-165) handles inputs directly with a built-in 20 channel scanner. Digital input options each handle 20 channels for up to 120 channels per mainframe or extender chassis. Total system capacity is as high as 1500 channels when extender chassis are used.

Information regarding 228X I/O Options is on page 128 in this catalog.

## Software

### Helios Toolbox

(Fluke Model 2289A-901)
Helios Toolbox for BASIC programmers is a set of software utilities that speeds software development in almost any application. These routines are used in the Microsoft QuickBASIC program development environment. These routines are intended to simplify software development by providing Helios-to-computer communications, automatic error checking, and buffer management routines. Special routines for Helios Plus (2287A) manage interval scanning, data buffering, alarm limit checking and "Burst Mode" (1000 channels per second) capability. Toolbox will even record your data directly into Lotus 1-2-3 Worksheet format.

You'll find that Helios Toolbox will significantly reduce software development time. Take advantage of these programming shortcuts when you need the top performance only custom software can deliver.

## Helios Logger Software

(Fluke Model 2289A-903) Helios Logger, is a general purpose software package that combines your PC with either Helios-I (2289A) or Helios Plus (2287A) to create a powerful data acquisition system. This is the package of choice when the additional functionality of Helios Plus (2287A) is required.

The Helios Logger menu system allows you to set up and control both the 2287A and 2289A mainframes and all their associated options. Control scanning, collect data, graph channels in real-time, and create data files that can be imported directly into Lotus 1-2-3 and Microsoft® Excel® spreadsheets. When used under Microsoft Windows® 3.0 (386 enhanced mode), Helios Logger software provides real-time data to other Windows applications via DDE.

# Specifications

## Mainframe Specifications

### 2289A, 2287A, or 2281A

**Mainframe Capacity:** 6 option slots
**2289A System Capacity:** 1500 channels
**2287A System Capacity:** −161 A/D: 1000 channels; −165 A/D: 800 single-ended, 400 differential
**Ambient Temperature:** Operating, 0°C to 65°C; storage, −40°C to 70°C
**Relative Humidity** (without condensation): 0°C to 25°C: <95%; 25°C to 40°C: <75%; 40°C to 50°C: <45%
**Altitude:** Non-operating, 12 km (40,000 ft); operating, 3 km (10,000 ft)
**Shock and Vibration:** Meets MIL-T-28800C, Class 5, Style F Standard
**Safety:** Designed to comply with ANSI/ISA-582, CSA Bulletin 556B, IEC 348, IEC-1010, and UL 1244
**Power:** AC: 90V to 132V, 180V to 264V, 47 Hz to 440 Hz; DC: 12V or 24V (optional). 40 watts maximum (50 watts maximum dc power)
**Weight:** 8.5 kg (18.7 lb) without options
**Size:** 23.8 cm H × 43.9 cm W × 35.9 cm D (9.37 in H × 17.25 in W × 14.13 in D); H (without feet) = 22.2 cm (8.75 in)

### 2287A Scan Buffer (Non-Volatile)

**Data Capacity (Readings)**

| Channels Per Scan | Readings |
|---|---|
| 1 | 12,300 |
| 5 | 27,500 |
| 10 | 32,000 |
| 20 | 35,900 |

**See page 128 for a description of all 228X I/O options.**

### Interface Specifications

**Communications Types:** Asynchronous, either RS-232C or RS-422
**Baud Rate:** 110, 300, 600, 1200, 2400, 4800, 9600, 19200, switch selectable
**Multi-Drop Capability:** Available via RS-422. Ten Helios mainframes can be addressed by a host through a single RS-422 port.

### Thermocouples (±°C)

| Type & Usable Range (°C) | Measured Temperature (°C) | 1 Year 15°C to 35°C | |
|---|---|---|---|
| | | -161 A/D | -165 A/D[2] |
| **J** NBS<br>(-200 to 760) | -100 to -25<br>-25 to 760 | 0.5<br>0.4 | 1.16<br>1.0 |
| **J** DIN<br>(-200 to 900) | -100 to -25<br>-25 to 900 | 0.56<br>0.45 | 1.17<br>0.98 |
| **K** NBS<br>(-225 to 1350) | 0 to 900<br>+900 to 1350 | 0.45<br>0.65 | 1.33<br>1.7 |
| **T** NBS<br>(-230 to 400) | -100 to 75<br>+75 to 150<br>+150 to 400 | 0.65<br>0.39<br>0.34 | 1.35<br>1.0<br>0.9 |
| **T** DIN<br>(-200 to 600) | 0 to 200<br>+200 to 600 | 0.53<br>0.41 | 1.07<br>0.85 |
| **E** NBS<br>(-250 to 838) | -100 to -25<br>-25 to 750<br>+750 to 810 | 0.54<br>0.33<br>0.4 | 1.15<br>0.94<br>0.94 |
| **N**[3] NBS<br>(-200 to 400) | -100 to 150<br>+150 to 400 | 0.7<br>0.44 | 1.75<br>1.2 |
| **R** NBS<br>(0 to 1767) | +250 to 450<br>+450 to 1767 | 1.0<br>0.9 | 3.0<br>2.76 |
| **S** NBS<br>(0 to 1767) | +200 to 1767 | 1.1 | 3.3 |
| **B** NBS<br>(200 to 1820) | +600 to 800<br>+800 to 1820 | 1.6<br>1.1 | 4.3<br>3.42 |
| **C** HOS<br>(0 to 2315) | +200 to 1000<br>+1000 to 2000<br>+2000 to 2315 | 0.66<br>1.2<br>1.7 | 2.0<br>3.35<br>4.55 |

[1] Resolution: 0.5°C on R, S, B, and C types; 0.1°C on J, K, L, and T types
[2] Continuous Mode only. For burst mode accuracy add 1.0°C to R, S, B, and C types; Add 3.0°C to J, K, E, T, and N types
[3] For 28 gauge thermocouple wire

## Helios Series Data Acquisition Front Ends

### Measurement Accuracy Accuracy (±% input ±offset)

| DC Volts | | |
|---|---|---|
| **A/D Option** | **Range** | **1 Year (15°C to 35°C)** |
| -161 A/D | ±64 mV<br>±512 mV<br>±8V<br>±64V | ±0.01% ±8 µV<br>±0.01% ±40 µV<br>±0.01% ±800 µV<br>±0.02% ±4 mV |
| -165 A/D<br>Continuous Mode<br>Differential Input | ±64 mV<br>±512 mV<br>±8V<br>±10.5V | ±0.03% ±25 µV<br>±0.03% ±100 µV<br>±0.03% ±1.2 mV<br>±0.03% ±1.7 mV |
| -165 A/D<br>Burst Mode<br>Differential Input | ±64 mV<br>±512 mV<br>±8V<br>±10.5V | ±0.03% ±35 µV<br>±0.03% ±150 µV<br>±0.03% ±1.7 mV<br>±0.03% ±2.2 mV |
| -165 A/D<br>Continuous Mode<br>Single-ended Input | ±64 mV<br>±512 mV<br>±8V<br>±10.5V | ±0.03% ±35 µV<br>±0.03% ±150 µV<br>±0.03% ±1.2 mV<br>±0.03% ±1.7 mV |
| -165 A/D<br>Burst Mode<br>Single-ended Input | ±64 mV<br>±512 mV<br>±8V<br>±10.5V | ±0.03% ±45 µV<br>±0.03% ±200 µV<br>±0.03% ±1.7 mV<br>±0.03% ±2.2 mV |
| **DC Current** | | |
| -161 A/D | ±64 mA | ±0.25% ±5 µA |
| -165 A/D[2] | ±64 mA | ±0.30% ±15 µA |
| **AC Volts** | | |
| -161 A/D | 5 to 250V ac[4] | ±1.0% ±0.1V |
| **Resistance** | | |
| -161 A/D, -163, -177 | 256Ω<br>2048Ω<br>64 kΩ | ±0.02% ±10 mΩ<br>±0.02% ±50 mΩ<br>±0.06% ±1.8 mΩ |
| -161 A/D, -162, -164<br>-174, -176 | 64Ω<br>512Ω | ±0.03% ±8 mΩ<br>±0.03% ±40 mΩ |
| -165 A/D, -164, -174<br>-176 (continuous) | 64Ω<br>512Ω | ±0.05% ±30 mΩ<br>±0.05%±100 mΩ |

[1] -161 A/D resolution for (50/60 Hz)
[2] Using 8Ω ±0.25% shunt mounted on screw terminals
[3] 18°C to 28°C operating temperature
[4] 45 Hz to 450 Hz

### RTD Performance w/-161, -163, -177 Options

| RTD Class | Measured Temperature | Resolution | Accuracy[4] | Repeatability |
|---|---|---|---|---|
| 385 DIN, 392, user-defined<br>4-wire, high resolution | -200 to +150<br>+150 to +425 | 0.006°C<br>0.006°C | ±0.09°C[5]<br>±0.13°C | ±0.03°C<br>±0.04°C |
| 385 DIN, 392, user-defined<br>4-wire, high temperature | -200 to +600°C | 0.05°C | ±0.25°C | ±0.14°C |
| 385 DIN, 392, user-defined<br>3-wire, accurate | -200 to +600°C | 0.05°C | ±0.007°C[6] | ±0.001°C[6] |
| 385 DIN, 392, user-defined<br>3-wire, isolated | -200 to +600°C | 0.05°C | ±1.97°C[7] | ±1.97°C[7] |
| 10Ω Cu, 4-wire | -75 to +150°C | 0.06°C | ±0.28°C | ±0.16°C |
| 10Ω Cu, 3-wire accurate | -75 to +150°C | 0.1°C | ±0.065°C[6] | ±0.008°C[6] |
| 10Ω Cu, 3-wire isolated | -75 to +150°C | 0.1°C | ±18.2°C[7] | ±18.2°C[7] |

### RTD Performance w/-161, -162, -164, -174, -176 Options

| RTD Class | Measured Temperature | Resolution | Accuracy[4] | Repeatability |
|---|---|---|---|---|
| 385 DIN | -200 to 600°C | 0.013°C | ±0.2°C | ±0.08°C |
| 10Ω Cu | -75 to 150°C | 0.1°C | ±1.0°C | ±0.2°C |

| Analog Output | Accuracy |
|---|---|
| **Current or Voltage Output** | **1 Year<br>15°C to 35°C** |
| **Option -164**<br>Transducer Excitation Module<br>Current Excitation<br>Voltage Excitation | <br><br>±0.03%<br>±0.04% |
| **Option -170**<br>Analog Output % of Range | <br>±0.2% |

### Strain Measurement[1]

| Type | Resolution | 90 Days (20°C to 30°C) |
|---|---|---|
| **-161 A/D[2]** | | |
| Full Bridge | 0.25 µε | ±0.05% ±2 µε |
| 1/2 Bridge | 0.5 µε | ±0.05% ±13 µε |
| 1/4 Bridge | 0.5 µε | ±0.05% ±25 µε |
| **-165 A/D[3]** | | |
| Full Bridge | 1.0 µε | ±0.1% ±6 µε |
| 1/2 Bridge | 2.0 µε | ±0.1% ±18 µε |
| 1/4 Bridge | 2.0 µε[4] | ±0.1% ±30 µε |

[1] -161 and -165 cover full useful range of gage
[2] Use with options -162, -164, -174, -176
[3] Use with options -164, -174, -176
[4] With 4V excitation

# Data Acquisition Tools

## Helios Series Data Acquisition Front Ends

### RTD Performance w/-165, -164, -174, -176 Options

| RTD Class | Measured Temperature | Resolution | Accuracy[4] | Repeatability |
|---|---|---|---|---|
| 385 DIN, 392 &<br>user-defined | -200 to 125°C<br>125°C to 600°C | 0.04°C<br>0.04°C | ±0.4°C<br>±0.54°C | ±0.1°C<br>±0.1°C |

[4] Total instrument accuracy, 18°C to 28°C, 90 days, (±°C)
[5] ±0.05°C ±(probe conformity), with ice-point initialization
[6] Add, per ohm lead resistance, to 4-wire specs
[7] Add to 3-wire accurate specs

### Helios Series I/O Option Selection Guide

| Measurement | I/O Module | Connector | Channels | Max Channels Per Chassis |
|---|---|---|---|---|
| Thermocouples | -161 and -162 | -175 | 20 | 100 |
| Thermocouples | -165 | -175 | 20 | 100 |
| DC Voltages | -161 and -162 | -175 or -176 | 20 | 100 |
| DC Voltages | -165 | -175 or -176 | 20 DE or 40 SE | 120 DE PR 240 SE |
| DC Current | -161 and -162 | -171 | 20 | 100 |
| DC Current | -165 | -176[1] | 20 | 120 |
| AC Voltages | -161 and -162 | -160 | 10 AC and 10 DC | 50 AC and 50 DC |
| RTDs | -161 and -163 | -177 | 20 | 100 |
| RTDs | -161 and -162 and -164 | -176 and -174 | 20 | 40 |
| RTDs | -165 and -164 | -176 and -174 | 20 | 60 |
| Resistance | -161 and -163 | -177 | 20 | 100 |
| Resistance | -165 and -164 | -176 and -174 | 20 | 60 |
| Resistance | -161 and -162 and -164 | -176 and -174 | 20 | 40 |
| Strain Gage | -161 and -162 and -164 | -176 and -174 | 20 | 40 |
| Strain Gage | -165 and -164 | -176 and -174 | 20 | 60 |
| Frequency/ Event Counting | -167 | Included | 6 | 30 |
| Status Input | -168 | -179 | 20 | 120 |
| Binary Input | -168 | -179 | 1 | 6 |
| BCD Input | -168 | -179 | 5 | 30 |
| Status Output | -168 | -169 | 20 | 120 |
| Analog Output | -170 | Included | 4 | 24 |

[1] Required: 8Ω shunt on each terminal pair, Fluke PN 641449

Note on configuration: Each 228X Mainframe chassis or extender chassis has capacity for up to 6 I/O modules. One A/D option is required in each chassis used to measure analog inputs. A connector option is required for every I/O module except the -161, -167, and -170. Up to 5 -162 scanners may reside in a single chassis with a -161. No scanners are used with the -165 A/D.

**See page 128 for complete description of 228X I/O options.**

## Ordering Information

### Models

**2287A** Helios Plus Mainframe ***$3990***
**2289A** Helios-I Mainframe ***$2990***
**2287A/AA** (12V Power) ***$5200***
**2289A/AA** (12V Power) ***$3990***
**2281A** Extender Chassis ***$1080***
**22810A** Helios-I (inc -161, -162 & -175) ***$4850***
**22811A** Helios Plus (inc -165 & -175) ***$5850***

### Included with Instrument

One-year product warranty, line cord, systems manual. 2281A operator manual and serial link cable. With 2281A-431 installed; instruction sheet and power cord.

### Options

See page 128 for descriptions of 228X I/O options for the Helios Series.

### Accessories

**Y1702** RS-232C Null Modem Cable, 4m ***$180***
**Y1707** RS-232C Standard Cable, 2m ***$180***
**Y2044** 24" Rack Slide and 8" Rack Mount Kit ***$235***
**Y2045** 8" Rack Mount Kit ***$180***
**Y2047** Serial Link 3-Way Adapter ***$90***

### Manuals

**2281A** Operator* (P/N 655688) ***$35***
**2287A** Service (P/N 865324) ***$135***
**2287A** System Vol 1 & 2 (P/N 865295) ***$150***
**2287A** System Vol 1 (P/N 873799) ***$56.50***
**2287A** System Vol 2 (P/N 885186) ***$56.50***
**2289A** System (P/N 794768) ***$103.50***
**2289A** Application Software (P/N 819862) ***$1***
**2289A** Service (P/N 834382) ***$195***
**2289A-901** Toolbox (P/N 819854) ***$15.50***

* No charge with purchase of unit

### Customer Support Services

### Factory Warranty

One-year product warranty.

# Data Acquisition

## Helios Logger Software

DOS based application software for the Helios Series

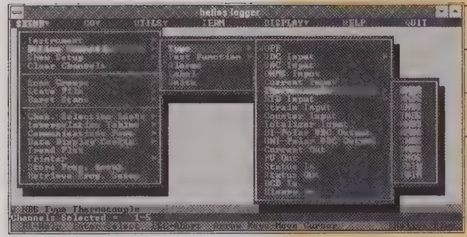
No programming required

Easy menu-based configuration — Quickly configure and start data collection

Extensive optional plotting and trending capabilities

Exchange data with Windows programs in real time with DDE

On-line help available at any time



### The Helios Logger PC Software Package brings out the power of Helios Data Acquisition Series Hardware.

**Helios Logger Data Acquisition Software** is a PC-based application program that configures and controls the Helios I and Helios Plus Data Acquisition Front Ends. Logger provides complete access to the accuracy and flexibility designed into your Helios Series mainframes and options, without programming. Helios Logger runs in the PC as a standard DOS application, but may also be run under Windows, providing additional data display and computational capabilities.

**No Programming:** Helios Logger is menu-based for ease of use. The menus automatically adapt to the Helios model (2287A or 2289A) being used so that only the relevant choices are presented. If you have a question, Logger's on-line context-sensitive help provides the information you need at the touch of a button.

**Configure Your Inputs:** The Helios Series offers a wide choice of I/O options. Helios Logger Software supports all these options and walks you through their setup. No matter how your Helios is configured, all of its features are easily enabled using your keyboard or mouse.

**"Channel Selection Lists" Accelerate System Configuration:** "Channel Selection Lists" make configuration of large numbers of channels easier than ever. Channel Selection Lists let you assign identical definitions to a block of channels, eliminating tedious individual channel programming. Each channel may then be individually modified for unique characteristics, such as user-defined channel label or sensor offset.

**Trend Graph Display:** Helios Logger displays measurement data graphically, in real-time. Customize your trend graph display by selecting up to 8 channels, and scaling the horizontal and vertical axes. Each plot is clearly distinguished by individual color and label. To enhance trend information, a digital readout of the latest value for each channel is displayed. Your own channel label precedes each digital readout for a meaningful display, in your terms.

**Advanced Trending Capabilities:** With Trend Link for Fluke, an optional comprehensive trend plotting package, you control how your data is displayed. You can quickly scroll through real time and historical data, or view data from all channels simultaneously, on a single screen. Or, you can plot one of multiple channels in real time, even superimposing channels on other channels. Record comments for future reference, by simply tagging notes to any point on a curve, which become a permanent part of the data file.

**User-Defined Displays:** Define up to four additional screens to organize your data display. Each screen contains up to 40 channels. Each channel has a unique label and appropriate engineering units. Assign a title to each display to further enhance the presentation. A single keystroke takes you from screen to screen so that your data is always at hand.

**Windows and Dynamic Data Exchange:** When used under Microsoft® Windows 3.0 (386 Enhanced Mode), Helios Logger Software provides data to other Windows applications using Dynamic Data Exchange (DDE). Using DDE you can graph and analyze data using Windows applications such as Microsoft Excel and Lotus 1-2-3® for Windows, *while Logger is gathering measurement data.*

**Automate Data Collection:** To record data as it is being measured, the "Data File" menu selection prompts you for the file name and the number of scans to skip between data recordings (to allow alarm checking, plotting, and display update to proceed at a higher rate than data recording). Data may be recorded in ASCII format for readability or binary format for compact storage. Files are easily imported into spreadsheet packages for additional analysis and presentation.

**Communication and Modem Operation:** When using Helios Logger, Helios communicates via RS-232C to the PC's COM1 or COM2 port. Helios Logger also supports communication through Hayes compatible modems to remotely located Helios units.

### System Requirements

- **Personal Computer**

Minimum requirement: IBM PC/AT or compatible, based on 80286. For best performance, a 386SX or higher is recommended. For operation under Windows 3.0 386 Enhanced Mode, a 386SX or higher is required.

- **Operating System**

DOS 3.3 or higher (DOS 5.0 recommended).

- **Serial Interface**

COM1: or COM2:

### Helios Toolbox

Helios Toolbox for BASIC programmers is a set of software utilities that speeds software development in almost any application. These routines are used in the Microsoft QuickBASIC program development environment. These routines are intended to simplify software development by providing Helios-to-computer communications, automatic error checking, and buffer management routines. Special routines for Helios Plus (2287A) manage interval scanning, data buffering, alarm limit checking and "Burst Mode" (1000 channels per second) capability. Toolbox will even record your data directly into Lotus 1-2-3 Worksheet format.

You'll find that Helios Toolbox will significantly reduce software development time. Take advantage of these programming shortcuts when you need the top performance only custom software can deliver.

## Ordering Information

### Models

**2289A-901** Helios Toolbox ***$400***

**2289A-903** Helios Logger Software Package ***$750***

**26XXA-904** Trend Link for Fluke ***$895***

**RS40** RS-232C Cable (AT-style 9 socket connector to Helios Series 25 socket connector). ***$30***

**Y1702** RS-232C Cable (null modem, 25 socket connector to 25 socket connector) ***$180***

# Data Acquisition Tools

## 2286A Data Logging System

Fluke's most powerful stand-alone data logger

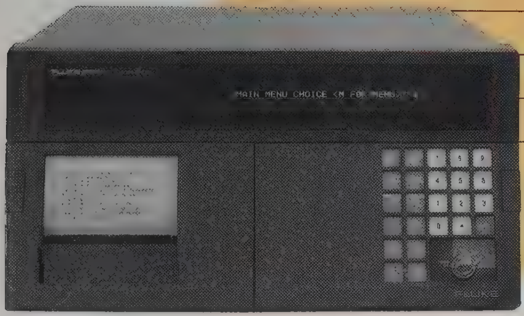
Expandable to 1500 channels*

Precision measurements on a wide variety of input types

3.5″ floppy drive, MS-DOS compatible

12V operation for mobile or field use

Pseudo-channels provide computing power without writing software



2286A

## 2285B Data Logger

Economical solution for simpler applications

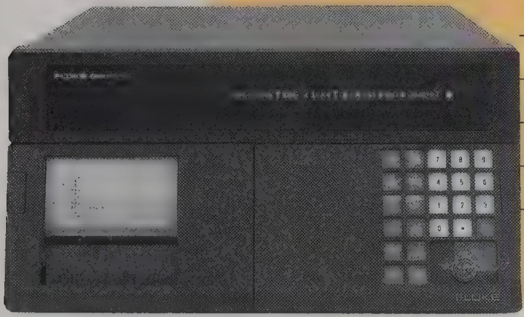
Expandable to 100 channels

Precision measurements on a wide variety of input types

Flexible report generation

12V operation for mobile or field use

Pseudo-channels give computer power without writing programs



2285B

The 2280 Series family of data loggers combines high measurement accuracy, exceptional configuration flexibility, and computer-like power without requiring the user to write software. This family, composed of the 2285B Data Logger and the more powerful 2286A Data Logging System, offers solutions for demanding data acquisition and reporting problems.

The 2286A Data Logging System features an MS-DOS compatible microfloppy drive for data and program storage. The disk can be taken from the 2286A, inserted directly into a PC, and the data files (stored in DIF format) imported into Lotus 1-2-3™, Excel, or other spreadsheets. The 2286A is expandable from a simple 20-channel data logger to a distributed 1500-point data acquisition system.

For applications that do not require all the power or expansion capabilities of the 2286A Data Logging System, the 2285B Data Logger is a more economical solution. Expandable up to 100 channels, the 2285B accepts most 228X I/O options.

The 2280 Series displays collected data, the results of calculations, or outputs can be viewed on its bright, 40-character display, or logged on the wide format 40-column internal printer. Adding further recording flexibility are two communication ports which can be configured with optional RS-232C or IEEE-488 interfaces.

### For Demanding Environments

Applications that require more input or output points than can be housed in the mainframe are satisfied by using the 2281A Extender Chassis. Any input or output options housed in an extender chassis have an operating range of −20°C to +70°C.

Another standard feature is full operation from 12V dc power, making the 2280 Series a natural for mobile data acquisition.

## Specifications

### 2280 Series System

**Maximum Inputs & Outputs:** ≤1500 channels per system (2286A) using 2281A Extender Chassis; ≤100 channels per system (2285B)

**Temperature:** 0°C to 50°C operating (2286A/ 2285B); −20°C to 70°C operating (2281A)

**Distance To Extender Chassis:** Any 2281A may be up to 1 km away from a 2286A/2285B

**I/O Capacity:** Each 2286A, 2285B, or 2281A extender classis provides six slots for input and output options. One of the six slots must contain an A-to-D converter option when one or more analog input options are used. Each analog input option will scan 20 channels and each status or digital input or output option will handle 20 lines.

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*Depending on programming requirements.

## 2286A/2285B Data Loggers

**Internal 3.5″ Disk Drive:** MS-DOS compatible disk drive used to store both data and programs. The data can be stored in DIF or ASCII text format. Storage capacity is up to 150,000 channel readings dependent upon disk density, data format and number of channels in a scan group.

**Internal Printer:** Uses thermosensitive paper, 110 mm (4.4 in) wide. Up to 40 alphanumeric characters per line printed from 5x7 dot matrix, 2.6 lines per cm (6.7 lines per in). Each line printed below the previous line. Will plot one to four graphs from scanned or calculated data, instead of alphanumeric characters, using distinctive symbol for each graph in any of 276 discrete positions across width of paper. Automatic paper take-up reel prevents spilling and allows withdrawal of any printed portion for review.

**Power:** 100, 120, 220, or 240V ac ±10%, 50 or 60 Hz. Or 10.5 to 15V dc. AC power will trickle-charge 12V battery for uninterrupted power. Less than 120W fully loaded.

**Size:** 22.23 cm H × 43.94 cm W × 66.17 cm L (9.35 in H × 17.30 in W × 26.05 in L)

**Weight:** 20-29 kg (45-66 lb) depending on configuration

**DC Voltage Accuracy:** ±(% of Rdg + Counts)*

| Range | 90 Days 15°C to 35°C | 1 Year 15°C to 35°C | 1 Year** −20°C to 70°C |
|---|---|---|---|
| ±64 mV | 0.005% + 7 | 0.01% + 8 | 0.03% + 9 |
| ±512 mV | 0.005% + 3 | 0.01% + 4 | 0.03% + 5 |
| ±8V | 0.005% + 7 | 0.01% + 8 | 0.03% + 9 |
| ±64V | 0.009% + 3 | 0.02% + 4 | 0.05% + 5 |

*Total instrument accuracy using Option −162 and −176

**A/D Converter must be in 2281A for operation to −20°C or 70°C

**Temperature Measurement Accuracy**

| Thermocouples | | Accuracy [1,3] | | |
|---|---|---|---|---|
| Type & Range (°C) | Temperature (°C) | 90 Days 15°C to 35°C | 1 Year 15°C to 35°C | 1 Year[2] −20°C to 70°C |
| J<br>−200 to 760 | −100 to +200<br>+200 to +760 | 0.35<br>0.45 | 0.4<br>0.5 | 0.9<br>0.76 |
| K<br>−275 to 1350 | −100 to +200<br>+200 to 1350 | 0.35<br>0.5 | 0.4<br>0.6 | 1.0<br>1.25 |
| T<br>−230 to 400 | −100 to +200<br>+200 to +400 | 0.35<br>0.45 | 0.4<br>0.5 | 1.0<br>0.6 |

Other thermocouple types supported: E, R, N, S, B, C, JDIN, KDIN

[1] Total instrument accuracy. Includes all instrument errors such as A/D errors, scanner errors, power supply warm-up, reference junction errors, conformity errors, etc.

[2] Total instrument accuracy using Option −162 and −175 in 2281A chassis.

[3] A/D Converter must be in 2281A for operation to −20°C or 70°C.

**RTD Measurement Accuracy (using −164, −174 options)**

| RTD Type & Range | Maximum Instrument Error* |
|---|---|
| 100Ω Platinum RTDs | |
| −200°C to +200°C<br>200°C to 600°C | 0.1°C<br>0.15°C |
| 10Ω Copper RTDs | |
| −75°C to +150°C | 1.0°C |

*Total Instrument Accuracy, 13°C to 33°C for 90 days.

**Resistance Measurement Accuracy (using −163, −177 options)**

| Range | Resolution | ±(% of Rdg + Ω) | |
|---|---|---|---|
| | | Accuracy | Repeatability |
| 256Ω | 2.4 mΩ | 0.017% + 5.7 mΩ | 0.0065% + 5.7 mΩ |
| 2048Ω | 19 mΩ | 0.017% ±38 mΩ | 0.0060% ±38 mΩ |
| 64 kΩ | 0.6Ω | 0.06% ±1.22Ω | 0.0075% ±1.22Ω |

*Total Instrument Accuracy, 15°C to 35°C for 90 days.

### Option −211, Math Coprocessor (2286A only)

**Functions:** Absolute value, square root, exponential, sine, cosine, tangent, arc sine, arc cosine, arc tangent, common logarithm, natural logarithm, $e^x$, exponentiation, integer part, maximum value, minimum value, standard deviation, elapsed time, group average AND, OR, NOT, EXCLUSIVE OR

**Relational Operators:**1<, ≤, >, ≥, =, ≠

**Interpolation Tables:** ≤10, user-entered. Number of points per table is limited only by system memory

### Option −341, RS-232C Interface

**Baud:** 110, 300, 600, 1200, 4800, 9600, or 19,200

**Parity:** Odd, even, or neither

Option −341 includes a Y1707 2-meter cable and a Y1705 null modem cable

### Option −342, IEEE-488 Interface

Operates as either a talker only, or talker/listener.

Order Y8021, Y8022, or Y8023 IEEE-488 cables separately

**See page 119 for description of PC compatible software.**

## Ordering Information

### Models

**2286A*** Data Logging System ***$9965***
**2285B*** Data Logger ***$7098***
**2281A**** Extender Chassis ***$1080***

* Not functional without 228X I/O modules
** One meter extender cable supplied unless -402/-403 option is ordered.

### Included with Instrument

One-year product warranty, line cord, manual set, 3.5″ high density disk, 3.5″ low density disk, one roll of printer paper, and one pad of programming forms.

### Options

**-211** Math Coprocessor (2286A) (factory or service center installation only) ***$1490***
**-341** RS-232C Interface ***$1100***
**-342** IEEE-488 Interface ***$1100***

### Accessories

**Y2044** 24″ Rack Mount and Slide Kit ***$235***
**Y2045** 8¾″ Rack Mount Kit ***$180***
**Y2046** Thermal Printer Paper (10 pack) ***$70***
**Y2047** Extender Chassis Multi-Connector ***$90***
**Y8091** 3.5″ Micro-Floppy Diskettes (10 pack) ***$85***
**A22-300** Transit Case for 2280A ***$710***

### Manuals

**2280** Start-up Guide (P/N 737320) ***$9.50***
**2280** User Guide (P/N 753103) ***$150***
**2280** System Guide (P/N 753095) ***$132.50***
**2280** Series Service (P/N 753111) ***$195***
**2281A** Operator (P/N 655688) ***$35***
**2286/85** User Guide (P/N 870170) ***$135***
**2286/85** System Guide (P/N 870175) ***$135***
**2286/85** Manual Set* (P/N 870167) ***$250***

*No charge with purchase of unit

# Calibration Instruments

5500A

**New Product**

734A

5700A

All electrical and electronic test and measurement instruments must be calibrated – when they are manufactured and at regular intervals to ensure accuracy and confidence in their measurements. Practically all instruments that measure voltage, current or resistance, can be calibrated with Fluke calibrators, standards, and auxiliary equipment.

In today's competitive marketplace, it's important to seize every possible advantage. The calibration hardware and software described on the following pages can contribute directly to product quality while controlling calibration expenses.

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### What is calibration?

Calibration is a process by which measurement instruments with an unknown amount of error are tested by comparing them to standards with a known error in order to detect and if necessary correct any variation in performance. In other words, calibration assures that measurement devices meet their performance specifications.

These comparisons often take place at various levels. A multimeter might be compared to a calibrator. In turn, the calibrator is compared to a group of standards, which in turn are measured by an accredited laboratory or national standards organization. This series or chain of intercomparisons establishes *traceability*, which is the goal of the calibration process – to assure that all measurements can be traced back to national standards through an unbroken chain of measurements.

### What are the benefits?

Calibration gives you confidence in the measurements you are making. Without it, measurements mean little, if anything. Instruments you depend on to measure product functionality or quality may give you false information, causing you to pass bad products or fail good products. In the end, a comprehensive calibration program increases quality and efficiency by making sure the measurements you rely on mean something.

National Standards

Fluke Primary Standards

734A Voltage Reference Standard
792B Direct Voltage Standards

Fluke Working Standards

742A Resistance Standards
732B Direct Voltage Standards
5790A/A40s AV & AI Standards

Fluke Production Calibration Instruments

5700A
High Accuracy Workload

5500A
Multi-Product Workload

Workload

884XA
Handhelds
8506A
Scopes
Other Bench Digital Multimeters >5.5 Digits
Temperature/Power
Data Loggers
Strip Chart Recorders

### Why is it important?

Calibration and traceability are essential to assure the quality of any design or production process. At the heart of any process is the ability to measure and control. Without calibration and the meaning it gives to measurements of all types, it is difficult to assure that processes are well controlled and that end products meet their specifications. That is why a documented calibration program is a key part of all major quality standards like ISO 9000, Q9000 and FDA GMPs.

### Why Fluke is the leader in dc/lf electrical calibration.

Our many years as both a user and supplier of calibration equipment have helped us to develop a unique understanding of your needs. The result of that understanding is a total solution of hardware, software and service before- and after-sale. These solutions provide performance, functionality and value in which you can be highly confident, both now and in the future. Fluke is the *wise* choice.

Our complete range of calibration solutions includes:

- A wide array of calibration instruments, accessories, management software to support the traceability of electrical and electronic measurement tools.
- Standards and services required to calibrate and service calibration instruments and keep them traceable to national standards.
- A range of support services and a world wide network of service centers backed up by a NVLAP-accredited standards laboratory and the Fluke 10V Josephson Array Standard.
- To help you the most out of your investment in Fluke products, we also offer training in metrology, laboratory management and software applications. MET/SUPPORT is a comprehensive support group with toll-free telephone access, fax, electronic bulletin board, electronic mail – all to help users to get the answers they need quickly.

FLUKE
Calibration:

Fluke provides a full spectrum of calibration standards, instruments, software and services to help you maintain the quality and traceability of your measurements. For more information on Fluke Calibration Products, contact your local representative.

## Selection Guide

The following chart lists a range of common dc/lf electrical calibration workload, as well as applications related to calibration, and the Fluke products that meet those requirements. You will find product descriptions in the pages that follow.

| Workload | Product | Options | Accessories | Options |
|---|---|---|---|---|
| **Digital multimeters <=5 digits** | 5500A | 5500A-SC<br>5500/CAL<br>MET/CAL | 5500A/LEADS<br>5500A/CASE<br>5500A/COIL<br>TL20 Cart<br>5500A/HNDL<br>5725A | |
| **Digital multimeters > 5 digits** | 5700A | 5700A-03<br>MET/CAL | 5725A, 5220A, 5440A-7002, 5700A-7002 | 5700A-200 |
| **Oscilloscopes <= 250 MHz** | 5500A | 5500A-SC<br>5500/CAL<br>MET/CAL | 5500A/LEADS<br>5500A/CASE<br>5500A/COIL, TL20 Cart, 5500A/HNDL, 5725A | |
| **Thermocouple/RDT thermometers** | 5500A | 5500A-SC<br>5500/CAL<br>MET/CAL | 5500A/LEADS<br>5500A/CASE<br>5500A/COIL<br>TL20 Cart<br>5500A/HNDL<br>5725A | |
| **Analog volt/ohm/amp meters** | 5500A | 5500A-SC<br>5500/CAL<br>MET/CAL | 5500A/LEADS<br>5500A/CASE<br>5500A/COIL<br>TL20 Cart<br>5500A/HNDL<br>5725A | |
| **Watt meters** | 5500A | 5500A-SC<br>5500/CAL<br>MET/CAL | 5500A/LEADS<br>5500A/CASE<br>5500A/COIL<br>TL20 Cart<br>5500A/HNDL<br>5725A | |
| **Power harmonics analyzers** | 5500A | 5500A-SC<br>5500/CAL<br>MET/CAL | 5500A/LEADS<br>5500A/CASE<br>5500A/COIL<br>TL20 Cart<br>5500A/HNDL<br>5725A | |
| **Process calibrators** | 5500A | 5500A-SC<br>5500/CAL<br>MET/CAL | 5500A/LEADS<br>5500A/CASE<br>5500A/COIL<br>TL20 Cart<br>5500A/HNDL<br>5725A | 8842A |
| **RF voltmeters**<br>**Chart/strip/XY recorders** | 5700A<br>5500A | 5700A-03<br>5500A-SC<br>5500/CAL<br>MET/CAL | 5725A, 5220A, 5440A-7002, 5700A-7002<br>5500A/LEADS<br>5500A/CASE<br>5500A/COIL<br>TL20 Cart<br>5500A/HNDL<br>5725A | |
| **Dataloggers** | 5500A | 5500A-SC<br>5500/CAL<br>MET/CAL | 5500A/LEADS<br>5500A/CASE<br>5500A/COIL<br>TL20 Cart<br>5500A/HNDL<br>5725A | |
| **Current clamps/clamp meters** | 5500A | 5500A-SC<br>5500/CAL<br>MET/CAL | 5500A/LEADS<br>5500A/CASE<br>5500A/COIL<br>TL20 Cart<br>5500A/HNDL<br>5725A | |
| **Automated calibration** | MET/CAL-4<br>MET/CAL-K4<br>5500/CAL | | | MET/CAL Training |
| **Measurement asset management** | MET/TRACK-4 | | | MET/TRACK Training |
| **Artifact calibration standards** | 5700A-7002 | 732B-000<br>732B-100 | | |
| **Direct voltage reference** | 734A | 732B-000<br>732B-100 | 5440A-7002<br>752A<br>720A | 732A-200<br>732A-201 |
| **Direct voltage transfer standards** | 732B | 732B-000<br>732B-100 | 5440A-7002<br>752A<br>720A | 732A-200<br>732A-201 |
| **Resistance Standards** | 742A Series | | | |
| **Alternating Voltage Standards** | 5790A<br>792A | 5790A-03 | A40/A40A<br>792A-7004 | |
| **Current Standards** | A40/A40A | | | |
| **Frequency Standards** | PM 6685 | | | |
| **Metrology training** | Metrology for Techs | | | |
| **Laboratory management training** | Lab Management | | | |
| **Software training** | MET/CAL<br>MET/TRACK | | | |
| **Calibration/metrology reference** | Cal-Book | | | |
| **Measurement assurance programs** | 732A-200 | | | 732A-201 |

FLUKE

# Calibration Instruments

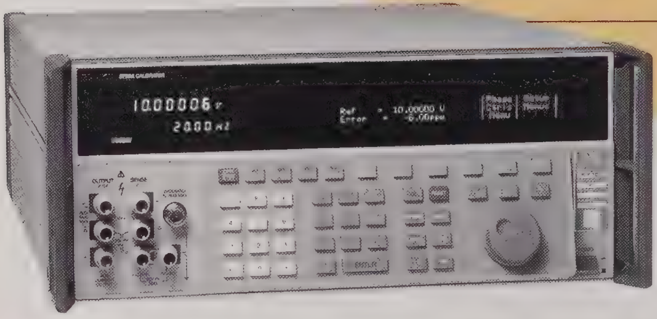
## 5700A Calibrator

Covers the high accuracy DMM calibration workload

Easy to use

Simplified support with Artifact Calibration

Confidence through Cal Check



5700A

The 5700A covers the complete range of digital multimeter calibration workload by sourcing direct and alternating voltage, direct and alternating current and resistance (see table).

The wideband voltage provides a flat, low-noise alternating voltage output from 10 Hz to 30 MHz to extend workload coverage to RF voltmeters. Output may be selected in volts or dBm referenced to 50Ω.

The companion 5725A amplifier extends the 5700A's workload coverage by increasing maximum alternating and direct current outputs to 11A. It also boosts the 5700A's volt/Hertz capability to 1100V at 30 kHz and 750V at 100 kHz. The 5725A is also compatible with the 5500A Multi-Product Calibrator.

### Simplified Support With Complete Confidence

Only three Artifact Standards, a 10V dc reference and 1Ω and 10 kΩ resistance references, are required to calibrate all 5700A ranges and functions to full specifications. The process, running under the control of the calibrator, takes about one hour. Instructions are displayed on the front panel to prompt the operator when to make various connections and inputs. For added confidence, Fluke recommends that a full verification of the 5700A be performed every two years or as required by your established procedures.

The 5700A does not need to be recalled to the standards laboratory for calibration. Due to its environmentally tolerant design, the 5700A may be calibrated wherever it is used, at any temperature between 15°C and 35°C. Full performance is available for ±5°C of that temperature.

Between Artifact Calibrations, the 5700A's performance may be checked against its internal standards. Without adjusting the instrument, an automated procedure is available to check each range and function against internal check standards to increase your confidence that it is within performance tolerances. Should any range be shown to be out of specification, the operator is alerted. All results of this Cal Check process can be printed via RS-232C port. This data can be used to develop control charts to predict the long-term performance of the calibrator.

### High Performance That's Easy to Use

Most technicians can learn to operate a 5700A with little or no training and without using a manual or reference cards.

Values are entered on the simple numeric keyboard and displayed on the front panel. The command is confirmed with the ENTER key. To verify the reading of the UUT, the operator simply adjusts the output knob and the error is displayed directly in ppm or %. Output values can be selected for editing using the arrow keys. Using the OFFSET and SCALE keys, the 5700A compensates for meter zero offset and scale errors and directly displays linearity errors at any scale level. The x10 and ÷10 keys simplify work on meters requiring calibration levels in even decade steps. Just multiply or divide any output value by pressing the corresponding key.

To protect the operator and UUT, limits on maximum output can be preset. For additional operator protection, the 5700A resets to standby mode when output is increased to more than 22V.

To meet your documentation needs and to improve quality and productivity, the 5700A is fully supported by Fluke's MET/CAL Automated Calibration Software.

### Low Cost of Ownership

The original purchase price is not the most significant cost associated with owning a high accuracy calibrator. Once the instrument is on the job, a wide range of calibration, maintenance, repair and training requirements increase its cost of ownership beyond the original purchase price many times over.

The 5700A Calibrator was designed to keep those traditional ownership costs down. Its powerful features are easy to use. Advanced internal metrology dramatically reduces support requirements while increasing your confidence in the instrument's performance. And its rugged, modular design increases reliability and makes problems easy to find and repair when they occur.

Another important factor in keeping instrument cost of ownership low is product reliability. Throughout its design and manufacture, the 5700A has been engineered to be the most reliable instrument of its type. Statistical process control techniques assure that quality is maintained, from component test through final assembly. Every 5700A is subjected to more than 2g of random vibration to prevent subtle imperfections from causing failures later on. A stiff chassis permits the 5700A to be moved with minimal risk of damage. Internal DIN connectors seal out potential environmental problems while keeping circuit boards firmly connected. Internal diagnostics exercise both digital and analog functions and can isolate problems to the board level, so repair often requires nothing more than the replacement of a plug-in module.

### Compatibility

The 5700A is designed to protect your investment in existing Fluke instruments and procedures. For example, a Fluke 5205A or voltage amplifier, and a Fluke 5220A transconductance amplifier may be connected directly to the 5700A through dedicated ports. In automated systems, the 5700A may be configured to emulate a 5100B so that existing procedures can be run with minimal modification.

| Function | Range |
|---|---|
| Direct Voltage | 0 to ±1100V |
| Alternating Voltage | 220 µV - 1100V 10 Hz-1.2 MHz |
| Resistance | 1Ω - 100 MΩ in × 1 and × 1.9 values |
| Direct Current | 0 to ±2.2A |
| Alternating Current | 220 µA to 2.2A 10 Hz - 10 kHz |

## 5700A Calibrator

## Specifications

These summary specifications are intended to give you a general idea of the instrument's overall uncertainty performance. Please consult the 5700A Technical Data Sheet for complete instrument specifications.

### DC Voltage

| Range | Absolute Uncertainty: ±5°C from Calibration Temperature | | | |
|---|---|---|---|---|
| | 24 Hours | 90 Days | 180 Days | 1 Year |
| | ±(ppm output + µV) | | | |
| 220 mV | 6.5 + 0.8 | 7 + 0.8 | 8 + 0.8 | 9.0 + 0.8 |
| 2.2V | 3.5 + 1 | 6 + 1 | 7 + 1 | 8.0 + 1 |
| 11V | 3.5 + 3 | 5 + 4 | 7 + 4 | 8.0 + 4 |
| 22V | 3.5 + 6 | 5 + 8 | 7 + 8 | 8.0 + 8 |
| 220V | 5 + 100 | 6 + 100 | 8 + 100 | 9.0 + 100 |
| 1100V | 7 + 600 | 8 + 600 | 10 + 600 | 11.0 + 600 |

(1) All footnotes from 5700A Calibrator Specifications (A0296D) apply.
(2) Zero must be executed within 24 hours prior to use.

### Resistance

| Nominal Value Ω | Absolute Uncertainty: ±5°C from Calibration Temperature | | | |
|---|---|---|---|---|
| | 24 Hours | 90 Days | 180 Days | 1 Year |
| | ±(ppm output + µV) | | | |
| 0 | 50µΩ | 50µΩ | 50µΩ | 50µΩ |
| 1 | 85 | 95 | 100 | 110 |
| 1.9 | 85 | 95 | 100 | 110 |
| 10 | 26 | 28 | 30 | 33 |
| 19 | 24 | 26 | 28 | 31 |
| 100 | 15 | 17 | 18 | 20 |
| 190 | 15 | 17 | 18 | 20 |
| 1k | 11 | 12 | 13 | 15 |
| 1.9k | 11 | 12 | 13 | 15 |
| 10k | 9 | 11 | 12 | 14 |
| 19k | 9 | 11 | 12 | 14 |
| 100k | 11 | 13 | 14 | 16 |
| 190k | 11 | 13 | 14 | 16 |
| 1M | 16 | 18 | 20 | 23 |
| 1.9M | 17 | 19 | 21 | 24 |
| 10M | 33 | 37 | 40 | 46 |
| 19M | 43 | 47 | 50 | 55 |
| 100M | 110 | 120 | 125 | 130 |

(1) All footnotes from 5700A Calibrator Specifications (A0296D) apply.
(2) Each value must be RANGE CAL'd after execution of artifact calibration.

### General Specifications

**Warm-up Time:** 2x the time since last warmed up, to a maximum of 30 minutes
**System Installation:** Rear output configuration and rack mount kit available
**Standard Interfaces:** IEEE-488, RS-232C, 5725A, 5205A or 5215A, 5220A, phase lock in (BNC), phase reference out (BNC)
**Temperature Performance:** Operating: 0°C to 50°C. Calibration: 15°C to 35°C. Storage: −40°C to 75°C. Tested for compliance with MIL-T-28800D, para. 4.5.5.1.1, Class 5.
**Relative Humidity:** Operating: <90% to 30°C, <70% to 40°C, <40% to 50°C. Storage <95%, non-condensing. Tested for compliance with MIL-T-28800D, para. 4.5.5.1.1, Class 5.
**Safety:** Designed to comply with UL 1244 (1987); IEC 348-19781 IEC 1010, CSA 556B, and ANSI/ISA-582
**Guard Isolation:** 20V
**EMI/RFI:** Designed to comply with FCC Rules Part 15, Subpart J, Class B; VDE 0871, Class B
**Vibration:** Tested for compliance with MIL-T-28800D, para. 4.5.5.3.1, Class 5
**Physical Shock:** Tested for compliance with MIL-T-2800C, para. 4.5.5.4.1, Class 5
**Reliability:** MIL-T-28800D, para. 3.13.3
**Line Power:** 47 to 63 Hz; ±10% allowed about selectable nominal line voltage: 100V, 110V, 115V, 120V, 200V, 220V, 230V, 240V
**Maximum Power:** 5700A, 300 VA; 5725A, 750 VA
**Size**
**5700A:** Height 17.8 cm (7 in), standard rack increment, plus 1.5 cm (0.6 in) for feet; width 43.2 cm (17 in), standard rack width; depth 63.0 cm (24.8), overall; 57.8 cm (22.7 in), rack depth
**5725A:** Height 13.3 cm (5.25 in); width and depth same as 5700A; both units project 5.1 cm (2 in) from rack front
**Weight:** 5700A: 27 kg (62 lb); 5725A: 32 kg (70 lb)

### Literature Available

5700A Technical Data Sheet
(Lit. No. A0296E)
Artifact Calibration: Theory & Application
(Lit. No. B0218A)
5700A Dialog
(Lit No. J0321B)

# 5700A Calibrator

## AC Voltage

| Range | Frequency Hz | Absolute Uncertainty: ±5°C from Calibration Temperature | | | |
|---|---|---|---|---|---|
| | | 24 Hours | 90 Days | 180 Days | 1 Year |
| | | ±(ppm output + µV) | | | |
| 2.2 mV | 10-20 | 500 + 5 | 550 + 5 | 600 + 5 | 600 + 5 |
| | 20-40 | 200 + 5 | 220 + 5 | 230 + 5 | 240 + 5 |
| | 40-20k | 100 + 5 | 110 + 5 | 120 + 5 | 120 + 5 |
| | 20k-50k | 340 + 5 | 370 + 5 | 390 + 5 | 410 + 5 |
| | 50k-100k | 800 + 8 | 900 + 8 | 950 + 8 | 950 + 8 |
| | 100k-300k | 1100 + 15 | 1200 + 15 | 1300 + 15 | 1300 + 15 |
| | 300k-500k | 1500 + 30 | 1700 + 30 | 1700 + 30 | 1800 + 30 |
| | 500k-1M | 3000 + 30 | 3300 + 30 | 3500 + 30 | 3600 + 30 |
| 22 mV | 10-20 | 550 + 6 | 550 + 6 | 600 + 6 | 600 + 6 |
| | 20-40 | 200 + 6 | 220 + 6 | 230 + 6 | 240 + 6 |
| | 40-20k | 100 + 6 | 110 + 6 | 120 + 6 | 120 + 6 |
| | 20k-50k | 340 + 6 | 370 + 6 | 390 + 6 | 410 + 6 |
| | 50k-100k | 800 + 8 | 900 + 8 | 950 + 8 | 950 + 8 |
| | 100k-300k | 1100 + 15 | 1200 + 15 | 1300 + 15 | 1300 + 15 |
| | 300k-500k | 1500 + 30 | 1700 + 30 | 1700 + 30 | 1800 + 30 |
| | 500k-1M | 3000 + 30 | 3300 + 30 | 3500 + 30 | 3600 + 30 |
| 220 mV | 10-20 | 500 + 16 | 550 + 16 | 600 + 16 | 600 + 16 |
| | 20-40 | 200 + 10 | 220 + 10 | 230 + 10 | 240 + 10 |
| | 40-20k | 95 + 10 | 100 + 10 | 110 + 10 | 110 + 10 |
| | 20k-50k | 300 + 10 | 330 + 10 | 350 + 10 | 360 + 10 |
| | 50k-100k | 750 + 30 | 800 + 30 | 850 + 30 | 900 + 30 |
| | 100k-300k | 940 + 30 | 1000 + 30 | 1100 + 30 | 1100 + 30 |
| | 300k-500k | 1500 + 40 | 1700 + 40 | 1700 + 40 | 1800 + 40 |
| | 500k-1M | 3000 + 100 | 3300 + 100 | 3500 + 100 | 3600 + 100 |
| 2.2V | 10-20 | 500 + 100 | 550 + 100 | 600 + 100 | 600 + 100 |
| | 20-40 | 150 + 30 | 170 + 30 | 170 + 30 | 180 + 30 |
| | 40-20k | 70 + 7 | 75 + 7 | 80 + 7 | 85 + 7 |
| | 20k-50k | 120 + 20 | 130 + 20 | 140 + 20 | 140 + 20 |
| | 50k-100k | 230 + 80 | 250 + 80 | 270 + 80 | 280 + 80 |
| | 100k-300k | 400 + 150 | 440 + 150 | 470 + 150 | 480 + 150 |
| | 300k-500k | 1000 + 400 | 1100 + 400 | 1200 + 400 | 1200 + 400 |
| | 500k-1M | 2000 + 1000 | 1100 + 1000 | 2300 + 1000 | 2400 + 1000 |
| 22V | 10-20 | 500 + 100 | 550 + 1000 | 600 + 1000 | 600 + 1000 |
| | 20-40 | 150 + 300 | 170 + 300 | 170 + 300 | 180 + 300 |
| | 40-20k | 70 + 70 | 75 + 70 | 80 + 70 | 85 + 70 |
| | 20k-50k | 120 + 200 | 130 + 200 | 140 + 200 | 140 + 200 |
| | 50k-100k | 230 + 400 | 250 + 400 | 270 + 400 | 280 + 400 |
| | 100k-300k | 500 + 1700 | 550 + 1700 | 550 + 1700 | 600 + 1700 |
| | 300k-500k | 1200 + 5000 | 1300 + 5000 | 1300 + 5000 | 1400 + 5000 |
| | 500k-1M | 2600 + 9000 | 2800 + 9000 | 2900 + 9000 | 3000 + 9000 |
| | | ±(ppm output + mV) | | | |
| 220V | 10-20 | 500 + 10 | 550 + 10 | 600 + 10 | 600 + 10 |
| | 20-40 | 150 + 3 | 170 + 3 | 170 + 3 | 180 + 3 |
| | 40-20k | 75 + 1 | 80 + 1 | 85 + 1 | 90 + 1 |
| | 20k-50k | 200 + 4 | 220 + 4 | 240 + 4 | 250 + 4 |
| | 50k-100k | 500 + 10 | 550 + 10 | 600 + 10 | 600 + 10 |
| | 100k-300k | 1500 + 110 | 1500 + 110 | 1500 + 110 | 1500 + 110 |
| | 300k-500k | 5000 + 110 | 5200 + 110 | 5300 + 110 | 5400 + 110 |
| | 500k-1M | 12000 + 220 | 12500 + 220 | 12500 + 220 | 13000 + 220 |
| 1100V | 50-1k | 75 + 4 | 80 + 4 | 85 + 4 | 90 + 4 |

Note: All footnotes from 5700A Calibrator Specifications (A0296D) apply.

## DC Current

| | Absolute Uncertainty: ±5°C from Calibration Temperature | | | |
|---|---|---|---|---|
| | 24 Hours | 90 Days | 180 Days | 1 Year |
| | ±(ppm output + nA) | | | |
| 220 µA | 45 + 10 | 50 + 10 | 55 + 10 | 60 + 10 |
| 2.2 mA | 45 + 10 | 50 + 10 | 55 + 10 | 60 + 10 |
| 22 mA | 45 + 100 | 50 + 100 | 55 + 100 | 60 + 100 |
| | ±(ppm output + µA) | | | |
| 220 mA | 55 + 1 | 60 + 1 | 65 + 1 | 70 + 1 |
| 2.2A | 75 + 30 | 80 + 30 | 90 + 30 | 95 + 30 |

Note: All footnotes from 5700A Calibrator Specifications (A0296D) apply.

## Ordering Information

### Models

**5700A** Calibrator *$26,950*

**5725A** Amplifier (includes interface cable) *$9950*

### Included with Instrument

One-year product warranty, line cord, getting started manual, operator manual and service manual.

### Option

**5700A-03** Wideband AC Voltage *$5950*

### Accessories

**5440A-7002** Low Thermal Cable Set *$475*

**5700A-7002** Portable Artifact Cal Package *$9900*
Includes 732B DC Standard, 742A-1 and 742A-10K Resistance Standards, 732B-7001 External Battery and Charger, 52 Digital Thermometer, 5440A-7002 Test Leads in a rugged shipping case

**732B** DC Voltage Reference Standard *$3990*

**742A-1** 1Ω Resistance Standard *$1575*

**742A-10k** 10 kΩ Resistance Standard *$1575*

**Y5701** Cable for 5205A or 5215A *$365*

**Y5702** Cable for 5220A *$365*

**Y5737** Rack Mount Kit with 24" slides for 5700A* *$450*

**Y5735** Rack Mount Kit with 24" slides for 5725A* *$450*

**Y8021** Shielded IEEE-488 Cable, 1m *$195*

**Y8022** Shielded IEEE-488 Cable, 2m *$210*

**Y8023** Shielded IEEE-488 Cable, 3m *$220*

*These rack slides allow for side ventilation

## Customer Support Services

### Factory Warranty

One-year product warranty.

# Calibration Instruments

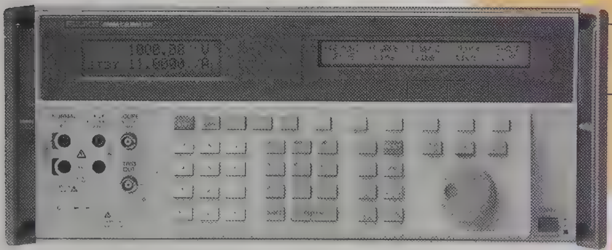
## 5500A Multi-Product Calibrator

The first multi-product calibrator.

11 Calibrators in one

Affordable wide workload coverage, including oscilloscopes

Easy to use, portable



5500A

**New**

The 5500A is a revolutionary product that addresses a wide cross-section of your electrical calibration work load. It sources direct voltage and current, alternating voltage and current with multiple waveforms and harmonics, two simultaneous voltage outputs or voltage and current, and simulates power with phase control, resistance, capacitance, thermocouples and RTDs. The 5500A-SC Oscilloscope Calibration option provides level sine wave, fast edge, time mark and amplitude signals for calibration of oscilloscopes up to 250 MHz (see table).

The 5500A was designed to cover a very wide range of medium accuracy electrical measurement devices including:

- Handheld and bench multimeters
- Oscilloscopes and ScopeMeter® Test Tools
- Wattmeters
- Analog volt/ohm/amp/watt instruments
- Electronic thermometers
- Data loggers
- Strip chart recorders
- XY Recorders
- Power harmonics analyzers
- Process calibrators
- Current clamps
- Panel meters
- And related instruments

Compared to more traditional calibrators designed to calibrate a certain type of instrument, the 5500A is a whole new class of *multi-product* calibrator covering an unprecedented range of dc and low frequency electrical calibration workload. When you team it with the optional 5500/CAL Calibration Software, the 5500A offers a complete, powerful and flexible solution for calibration documentation and reporting according to today's quality standards like ISO 9000.

The standard instrument can calibrate digital and analog multimeters, thermometers (thermocouple and RTD) handheld wattmeters, data loggers, current clamps, various types of recorders, panel meters, process calibrators, power harmonics analyzers and many other similar measurement tools.

The 5500A-SC option further extends coverage to the most widely used analog and digital oscilloscopes. This option can be included at time of purchase, or added later at any authorized service center.

The 5500A includes all the traditional meter calibration source functions — voltage, current and resistance. Plus it adds capacitance, and both resistance and capacitance are continuously variable with resolution down to 1 mΩ or 0.1 pF. Both are easy and practical to use with a wide variety of measurement tools.

Power is simulated using dual dc or ac outputs, allowing you to source two voltages or voltage plus current at the same time with precise phase control for wattmeter or power harmonics analyzer calibration. And the 5500A simulates a wide range of thermocouples and RTDs for temperature calibration.

### Flexibility, Accuracy and Value

For all its capabilities, the 5500A is remarkably affordable. For about the same price you would expect to pay for a calibrator for one type of instrument, the 5500A can provide you with far more, making cost justification easy. And when you consider how your workload might change in the future, the 5500A is an even better value. So instead of buying several standards, the 5500A meets your needs with a single, compact tool.

The 5500A also features the stability, linearity and low noise performance common to all Fluke calibrators. Each unit is shipped with test data and a certificate of traceability to nationally recognized standards.

### Compliance with Quality Standards made Easy

With quality control standards such as ISO 9000, there is a lot more to calibration than just making measurements. You also have documentation, control and reporting requirements to meet.

Our optional Microsoft Windows-based 5500/CAL simplifies the documentation of your procedures, adequacy and traceability as required by ISO 9000 and other similar quality standards. It also collects and reports calibration results information and helps consistently, quickly and efficiently calibrate a wide variety of instruments. 5500/CAL is a special version of our MET/CAL designed to work with the 5500A and a Fluke 45 DMM. Because it controls instruments via an RS-232 (serial port), no IEEE interfaces are required. That means that with a 5500A, a notebook computer and 5500/CAL, your whole calibration process can be automated, from creation of procedures to execution through results data collection and reporting. More than 200 procedures are included. They can be run as is, edited to fit your specific needs, or used as the basis to create new procedures.

### Operation is Easy

With the 5500A, we took great care to make the calibrator as easy as possible to use. For almost everything you do with the 5500A, your hand moves naturally from left to right. Values are entered from the calculator-style keyboard. Values can be stepped up and down in even decades (1-2-5 sequence in scope mode) with the multiply and divide keys. Specifications for any value can be viewed with the push of a button.

The 5500A's display is rugged, bright and easy to read from all angles. Output and information is clearly displayed so instrument status can be determined easily at a glance.

## Temperature Calibration

| **Function** | **Range** |
|---|---|
| Direct Voltage | 0-1000V |
| Alternating Voltage | 1 mV - 1000V 0.01 Hz - 500 MHz |
| Direct Current | 0-11A |
| Alternating Current | 33 µA - 11A 10 Hz - 10 kHz |
| Resistance | 0 - 330 MΩ |
| Capacitance | 330 pF - 1 mF 50 Hz - 1 kHz |
| Direct Power | 0 - 11 kW |
| Alternating Power | 33 nW - 11 kW |
| Phase Control | 0 - 179.99°, 0.02° Resolution, degrees or PF |
| Temperature (Source) | -250°C - +2316°C, B C E F K N R S T Thermocouples, Pt385, Pt 3926, PtNi 385 (Ni120) RTDs |
| Temperature (Measure) | -250°C - +2316°C, B C E F K N R S T Thermocouples |
| Waveforms | Sine, square, triangle, truncated sine |
| Harmonics | 2 - 50 of fundamental |
| **5500A-SC Scope Cal Option** | |
| Leveled Sine Wave | 50 kHz - 250 MHz, 50W 5 mV - 5Vp-p |
| Fast Edge | [ 1ns, 50Ω 10 mV - 2Vp-p |
| Time Marks | 2 ns - 5s in 1-2-5 sequence |
| Voltage | 10 mV - 50Vp-p, 1 MΩ in 1-2-5 sequence, dc, 10 Hz - 10 kHz<br>10 mV - 2Vp-p, 50Ω in 1-2-5 sequence, dc, 10 Hz - 10 kHz |

## Specifications

### Thermocouple - Simulation & Measurement Mid-Range J & K Types

| **TC Type** | **Absolute Uncertainty, tcal ±5°C ± (degrees C) [1]** | |
|---|---|---|
| | **90 days** | **1 year** |
| J | 0.10 | 0.14 |
| K | 0.12 | 0.16 |

[1] Does not include thermocouple error.

- Simulates and measures B, C, E, J, K, N, R, S and T thermocouples.
- Temperature span is from −250°C to 2316°C.
- ITS-90 or IPTS-68 is selectable.
- 0.01°C resolution.

### RTD - Simulation Mid-Range

| **RTD Type** | **Absolute Uncertainty, tcal ±5°C (degrees C)** | |
|---|---|---|
| | **90 days** | **1 year** |
| Pt 385, 100 Ω | 0.05 | 0.05 |
| Pt 392, 100 Ω | 0.05 | 0.05 |
| PtNi(385), 120 Ω | 0.06 | 0.07 |

- Simulates three RTD types.
- −200°C to 800°C.
- ITS-90 or IPTS-68 is selectable.
- 0.003°C resolution.
- 2-wire or 4-wire compensation is selectable.

### DC Voltage

| **Range (Volts)** | **Resolution (µV)** | **Absolute Uncertainty, tcal ±5°C ± (% of output + µV)** | | | |
|---|---|---|---|---|---|
| | | **90 days** | | **1 year** | |
| 330 mV | 0.1 | 0.005 | 3 | 0.006 | 3 |
| 3.3 | 1 | 0.004 | 5 | 0.005 | 5 |
| 33 | 10 | 0.004 | 50 | 0.005 | 50 |
| 330 | 100 | 0.0045 | 500 | 0.0055 | 500 |
| 1000 | 1000 | 0.0045 | 1500 | 0.0055 | 1500 |
| Auxiliary Output (dual output mode only) | | | | | |
| 330 mV | 1 | 0.03 | 350 | 0.04 | 350 |
| 3.3 | 10 | 0.03 | 350 | 0.04 | 350 |

- Two channels of dc voltage output are provided.

### DC Current

| **Range (Amps)** | **Resolution (µA)** | **Absolute Uncertainty, tcal ±5°C ± (% of output + µA)** | | | |
|---|---|---|---|---|---|
| | | **90 days** | | **1 year** | |
| 3.3 mA | 0.01 | 0.010 | 0.05 | 0.013 | 0.05 |
| 33 mA | 0.1 | 0.008 | 0.25 | 0.01 | 0.25 |
| 330 mA | 1 | 0.008 | 3.3 | 0.01 | 3.3 |
| 2.2 | 10 | 0.023 | 44 | 0.03 | 44 |
| 11 | 100 | 0.038 | 330 | 0.06 | 330 |

- The 5725A Amplifier can be used to increase the compliance voltage.

### Resistance Mid-Ranges

| **Range (Ω)** | **Resolution (Ω)** | **Absolute Uncertainty, tcal ±5°C ± (% of output + Ω)** | | | |
|---|---|---|---|---|---|
| | | **90 days** | | **1 year** | |
| 1.1k | 0.01 | 0.007 | 0.06 | 0.009 | 0.06 |
| 3.3k | 0.01 | 0.007 | 0.06 | 0.009 | 0.06 |
| 11k | 0.1 | 0.007 | 0.6 | 0.009 | 0.6 |
| 33k | 0.1 | 0.007 | 0.6 | 0.009 | 0.6 |

- Continuously variable from 0 to 329.999 MΩ.
- Current handling capability is > 100 mA on the lowest range (11 Ω) and > 50 nA on the highest range (330 MΩ).
- 2-wire or 4-wire compensation is selectable.

### AC Voltage Mid-Band (45 Hz - 10 kHz), Primary Output

| **Range (Volts)** | **Resolution (µV)** | **Absolute Uncertainty, tcal ±5°C ± (% of output + µV)** | | | |
|---|---|---|---|---|---|
| | | **90 days** | | **1 year** | |
| 33 mV | 1 | 0.11 | 20 | 0.15 | 20 |
| 330 mV | 1 | 0.04 | 20 | 0.05 | 20 |
| 3.3 | 10 | 0.02 | 60 | 0.03 | 60 |
| 33 | 100 | 0.03 | 600 | 0.04 | 600 |
| 330 [1] | 1000 | 0.04 | 6.6 mV | 0.05 | 6.6 mV |
| 1000 [1] | 10000 | 0.04 | 80 mV | 0.05 | 80 mV |
| Mid-Band (45 Hz – 1 kHz), Auxiliary Output (dual output mode only) | | | | | |
| 330 mV | 1 | 0.08 | 370 | 0.1 | 370 |
| 3.3 | 10 | 0.07 | 450 | 0.09 | 450 |

[1] These specifications apply from 45 Hz to 1 kHz.

- Two channels of ac voltage output are provided.
- Sine, triangle, square and truncated sine waveforms are available from both channels.
- Harmonics of the primary output are available from the Auxiliary Output.
- Complete frequency span of the main output channel is from 10 Hz to 500 kHz.
- An extended bandwidth down to 0.01 Hz is available for outputs <33V. An upper bandwidth limit of 2 MHz is available on the 3.3V range for sinewaves.
- The 5725A Amplifier can be used to extend the Volt × Hertz limits, as well as increase the burden current capability.

# 5500A Multi-Product Calibrator

## AC Current
## Mid-Band (45 Hz - 1 kHz)

| Range (Amps) | Resolution (µA) | Absolute Uncertainty, tcal ±5°C ± (% of output + µA) 90 days | | 1 year | |
|---|---|---|---|---|---|
| 330 µA | 0.01 | 0.09 | 0.15 | 0.125 | 0.15 |
| 3.3 mA | 0.01 | 0.08 | 0.30 | 0.1 | 0.3 |
| 33 mA | 0.1 | 0.07 | 3 | 0.09 | 3 |
| 330 mA | 1 | 0.07 | 30 | 0.09 | 30 |
| 2.2 | 10 | 0.08 | 300 | 0.1 | 300 |
| 11[1] | 100 | 0.08 | 2000 | 0.1 | 2000 |

[1] These specifications apply from 45 Hz to 500 Hz.

- Sine, triangle, square and truncated sine waveforms are provided.
- Complete frequency span of ac current is from 10 Hz to 10 kHz.
- An extended bandwidth down to 0.01 Hz is available.
- The 5725A Amplifier can be used to extend the compliance voltage.

## Capacitance
## Mid-Ranges

| Range (F) | Resolution (pF) | Absolute Uncertainty, tcal ±5°C ± (% of output + nF) 90 days | | 1 year | |
|---|---|---|---|---|---|
| 110 nF | 10 | 0.19 | 0.1 | 0.25 | 0.1 |
| 330 nF | 10 | 0.19 | 0.3 | 0.25 | 0.3 |
| 1.1 µF | 100 | 0.19 | 1 | 0.25 | 1 |

- Continuously variable from 330 pF to 1 mF.
- Specifications apply to both "dc charge/discharge" capacitance meters and ac RCL meters.

## Power
## Mid-Band (45 – 65 Hz), PF=1

| Voltage Output (Volts) | Absolute Uncertainty, tcal ±5°C ± (% of output + mW) 1 year Current Output (Amps) 0.33 – .8999 | 0.9 – 2.1999 | 2.2 – 4.4999 | 4.5 – 11 |
|---|---|---|---|---|
| 330 mV - 1000V | 0.20 | 0.12 | 0.18 | 0.12 |

- Other frequencies (10 Hz to 10 kHz) and dc are provided.
- Phase is adjustable from 0 to 90 degrees, with resolution of 0.02 degrees.
- Phase uncertainty is 0.15 degrees from 45 to 65 Hz.
- Sine, triangle, square and truncated sine waves are available. Harmonics of either the voltage or current channel can be selected.
- Can be used with the 5725A Amplifier to increase drive capability.

## Voltage Calibration

| | |
|---|---|
| Output into 1 MΩ Load | 10 mV to 50V peak-to-peak |
| Output into 50 Ω Load | 10 mV to 2V peak-to-peak |
| Range Settings | 1-2-5 steps |
| Adjustment Range | 10% |
| Frequency Span | dc, 10 Hz to 10 kHz |

## Edge

| | |
|---|---|
| Amplitude (50 Ω load) | Over 1V peak-to-peak |
| Risetime | < 1 ns |
| Output Resistance | 50 Ω |
| Output Period | 1 µs to 1 ms |

## Leveled Sinewave

| | |
|---|---|
| Frequency Range | 50 kHz – 250 MHz |
| Amplitude Range | Up to 5V peak-to-peak into 50 Ω termination |
| Output Source Resistance | 50 Ω |
| External Trigger Output Signal | Signal locked to the leveled sinewave. Maximum Trigger Output frequency is 10 MHz. |

## Time Mark

| | |
|---|---|
| Marker Range | 2 ns through 5s in a 1-2-5 sequence |
| Marker Amplitude | > 500 mV into 50 Ω |
| External Trigger Output Signal | Signal locked to the time markers. Smallest Trigger Output period is 100 ns. |

## General Specifications

### Warm-Up Time
2X the time since last warmed up, to a maximum of 30 minutes.

### Standard Interfaces
IEEE-488, RS-232, 5725A.

### Temperature Performance
**Operating:** 0°C to 50°C. Calibration: 15°C to 35°C.

### Storage
−20°C to 70°C.

### Relative Humidity
Operating: <80% to 30°C, <70% to 40°C, <40% to 50°C. Storage: <95%, non-condensing.

### Safety
Designed to comply with IEC 1010-1 (1992-10); CSA 22.2 #231-M.

### Analog Low Isolation
20 volts.

### EMI/RFI
Designed to comply with FCC Rules Part 15; VFG 243/1991.

### Reliability
MIL-T-28800D, par. 3.13.3.

### Line Power
±10% allowed about selectable nominal line voltage: 100V, 120V, 200V, 240V; 47 to 63 Hz.Maximum power: 5500A, 250VA; 5725A, 750VA.

### Size
**5500A:** Height 17.8 cm (7 in), standard rack increment, plus 1.5 cm (0.6 in) for feet; Width 43.2 cm (17 in), standard rack width; Depth 47.3 cm (18.6 in) overall. **5725A:** Height 13.3 cm (5.25 in); Width same as 5500A; Depth 63.0 cm (24.8 in) overall.

### Weight
**5500A:** 20 kg (44 lbs); **5725A:** 32 kg (70 lbs).

### Literature Available
- 5500A Brochure (G0346)
- 5500A Technical Data Sheet (J0479C)
- MET/CAL Data Sheet (A0531A)
- MET/CAL Sample Version (J0403C)
- How Many Calibrators Do You Need to Meet ISO 9000? (B0252A)

### Oscilloscope Calibration Option
- All outputs except external trigger are available at the main BNC output.
- External trigger has a separate BNC connector.

## Ordering Information

### Factory Warranty
Included are a one year warranty, certificate of calibration with data, line cord, operator manual, demonstration guide.

### Models
**5500A** Multi-Product Calibrator ***$9995***

### Options
**5500A-SC** Oscilloscope Calibration Option ***$6500***

### Accessories
**5500/CAL** Calibration Software ***$2500***
**5500A/LEADS** Test Lead Kit ***$495***
**5500A/HNDL** Carrying Handle ***$80***
**5500A/CASE** Transit Case ***$595***
**Y5537** Rack Mount Kit ***$450***
**TC100** Instrument Cart ***$540***
**5500A/COIL 50** Turn Coil for current clamps ***$595***

# 5220A Transconductance Amplifier

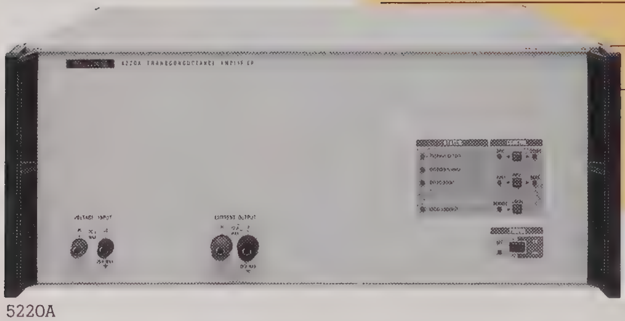
20 amps output dc or rms ac

0.025% basic dc accuracy

Over-voltage and over-current protection

Over-temperature protection

May be programmed through a 5700A or 5100B



5220A

The 5220A Transconductance Amplifier lets you calibrate alternating or direct current meters and shunts and the current functions of digital multimeters that measure up to 20A. A known input voltage of 1 to 20 volts produces a known output current of 1 to 20A.

The 5220A is designed to be controlled by a 5700A or 5100B Series calibrator but may be driven by another voltage source such as the 5200A or 5500A. When used with a 5100B Series or 5700A, the current range of those instruments is extended by a factor of 10 to 1. Options are available for the 5100B Series that make the system GPIB/IEEE-488* and RS-232C compatible.

### Built-in Protection

Protection is designed in to eliminate problems caused by excessive inputs, open inputs, and overcompliance. Indicators on the front panel tell the user about any of these conditions. Automatic shut down occurs should the internal temperature rise excessively.

### Remote Operation

Drive voltage to the 5220A may be introduced through the front panel or the rear panel. The connector on the rear, however, allows the 5220A to become an extension to the current range of a 5700A or 5100B Series Calibrator.

The two instruments operate as one integrated calibration system with all the advantages of single control-point calibration; automatic error calculation, entry limit protection, etc.

A 5100B Series Calibrator requires a Y5000 Interface/Buffer to control a 5220A. A single Y5000 Interface Buffer may also be used to control a 5205A Power Amplifier.

* The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

## Specifications

The specifications below apply for 180 days for instruments operated between 20°C and 30°C in a relative humidity of 70% or less.

**Transconductance:** 1 siemens (1A per volt)

**Output Range:** 0 to 20A dc or rms ac (28.3A peak)

**Maximum Compliance Voltage:** ≥±4V dc, or 3V rms ac (4.25V peak)

**DC Accuracy:** ±(0.025% of output +1 mA)

**AC Accuracy:** ±(0.05% of output +1 mA) from 30 Hz to 1 kHz, and ±(0.05% of output +1 mA) × f from 1 kHz to 5 kHz, where f = frequency in kHz

**Short Term DC Stability:** Output changes less than ±(0.005% + 200 μA) in 10 minutes, with constant line, load, and temperature

**Short Term AC Stability:** Output changes less than ±(0.01% + 500 μA) in 10 minutes, with constant line, load, and temperature

**Harmonic Distortion and Noise:** ±(0.05% of output ±1 mA) over frequency range of 30 Hz to 1 kHz and measured with a noise bandwidth of 300 kHz, ±0.05% of output +1 mA) × f from 1 kHz to 5 kHz, where f = frequency in kHz

**Temperature Coefficient:** ±(0.0025% of output +100 μA) per degree C, above 30°C or below 20°C

**Transient Recovery:** Output will settle to within 0.01% of final value within 2 seconds following a programmed change in output current or frequency (10 ms for 5220A alone)

**Load Capability:** Drives all resistive and capacitive loads consistent with current and compliance voltage capability. Drives inductive loads (with reduced accuracy) up to 200 microhenries, consistent with current and compliance voltage capability

**Maximum Isolation Voltage:** ±20V dc or 20V ac rms

**Temperature Range:** 0°C to 50°C (operating) and −20°C to 65°C non-operating

**Relative Humidity:** ≤50% to 50°C, ≤75% to 40°C, ≤95% to 25°C

**Altitude:** 0 to 10,000 feet (operating) and 0 to 40,000 feet (non-operating)

**Vibration:** 2G maximum, 5 Hz to 55 Hz for 15 minutes

**Shock:** 15G maximum, half sine waves

**Power:** 100, 110, 115, 120, 200, 220, 230, or 240V ac +10%, switch-selectable, 50 Hz to 60 Hz, 300W

**Size:** 17.8 cm H × 43.2 cm W × 55.9 cm D (7 in H × 17 in W × 22 in D), case only

**Weight:** 227 kg (50 lb)

## Ordering Information

### Model

**5220A** Transconductance Amplifier ***$7500***

### Included with Instrument

One-year product warranty, line cord, Instruction manual, Certificate of Calibration Practices.

### Accessories

**Y5020** Current Shunt ***$1055***
**Y5000*** Interface Buffer ***$945***
**Y5002*** Cable (Y5000 to 5220A) ***$370***
**Y5702** Cable (5700A to 5220A) ***$365***
**M07-205-600** 7" Rack Mount Kit ***$175***
**M00-270-610** 20" Slides for Rack Mount Kit ***$195***
**M00-280-610** 24" Slides for Rack Mount Kit ***$195***

*Required when controlled from 5100B or 5101B

### Manuals

**5220A** Instruction** ***$50***

**No charge with purchase of unit

## Customer Support Services

### Factory Warranty

One-year product warranty.

# Calibration Software

## MET/CAL Calibration Management Software

A powerful, flexible, full-featured automated calibration system.

Supports today's quality programs like ISO 9000

Documents procedures, results, traceability and adequacy.

Flexible and easy to use. Packed by MET/SUPPORT

| Conventional Manual Procedure | Automated MET/CAL Procedure |
|---|---|
| 1. Turn on the meter.<br>2. Allow the meter to warm up for 30 minutes.<br>3. Select the meter's 10V dc range.<br>4. Set the calibrator's output to 10V dc.<br>5. Verify that meter error is not more than 0.005%. | 1. DISP Turn on the meter.<br>2. DISP Allow the meter to warm up for 30 minutes.<br>3. 5700 10V .005%. |

MET/CAL is a powerful, flexible, full-featured automated calibration environment for PCs running Microsoft Windows. With it, you can create and edit calibration procedures using a wide range of standards, run those procedures, collect test data, generate calibration reports and certificates, and export data to other software applications.

A special version of MET/CAL called 5500/CAL is available for use with the 5500A Multi-Product Calibrator. It is an RS-232 based system that permits you to automate without the need for IEEE-488 interfaces. It can control a 5500A and a serial UUT from one PC serial port. More than 200 procedures are included.

MET/CAL is a powerful, flexible full solution for electrical calibration workload, including multimeters, oscilloscopes, thermometers, data loggers, watt meters, calibrators, recorders and more. MET/CAL also has the flexibility to address the calibration requirements of other non-electrical measurement instruments like gage blocks, micrometers, strain gages and so on.

In contrast to simpler products, MET/CAL can control more than 20 calibration instruments over an IEEE-488 interface. Even more can be addressed through the IEEE command. Information on each standard — its performance capabilities, specifications and calibration status are maintained within MET/CAL. This permits you to specify minimum test uncertainty ratios at any output scale, report measurement uncertainty, enforce test adequacy and traceability and assure standards are in calibration.

MET/CAL uses a procedure-oriented building block approach to creating procedures, providing flexibility to allow your tests to be as simple or comprehensive as you need them to be. Function Select Codes (FSCs) represent various standards and functions used during a test. Creating procedures is simply a matter of combining FSCs and test parameters.

More than 300 procedures for an extraordinary range of test instruments from a variety of manufacturers is included at no extra charge. Most can be run as is, customized to meet specific requirements, or used as the basis to create new procedures. A library of connection diagrams is also included. Test run modes and error trapping make short work of debugging procedures. The AutoPro utility can help you to generate procedures automatically by filling out a spreadsheet with instrument specifications.

Automated calibration has a dramatic and positive effect on the consistency and quality of your tests. And thanks to plain language operator prompts, illustrations and hook-up diagrams, technicians can perform complex calibrations confidently.

MET/CAL supports three basic types of calibrations. The first is manual calibrations, where MET/CAL prompts the operator to enter values indicated on the UUT, calculates the error and records the result. With closed case procedures, MET/CAL controls both the standard and the unit under test through the IEEE bus. Closed loop calibrations make it possible to perform both verifications and adjustments on UUTs automatically with little or no operator involvement.

MET/CAL allows you manage access to your system and information through password control. Security levels range from "look only" to procedures and results access, to procedure editing and execution.

Test reports and certificates can be customized to fit your operating requirements. Post test data can be printed, saved to disk, or saved as delimited ASCII for exporting to other software applications like Fluke's MET/TRACK.

MET/CAL is supported by Fluke's MET/SUPPORT program. With it you gain access to electronic mail, a computer bulletin board service, a user's group, newsletter, and fax and toll-free phone access to get help with your questions. Fluke also offers comprehensive MET/CAL procedure writing training to help you get your system up and running fast.

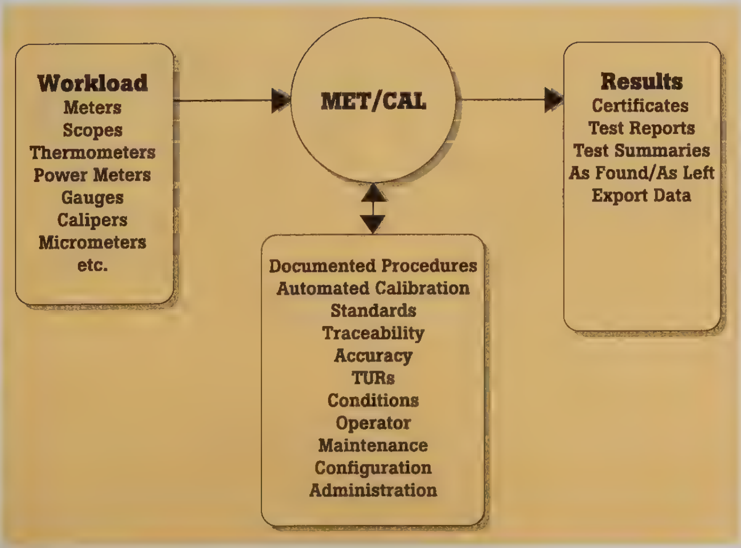


Figure 1. MET/CAL workload diagram.

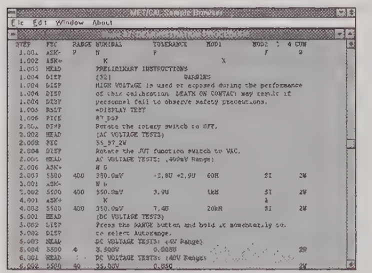
# Calibration Software

## MET/CAL Calibration Management Software

### Hardware Requirements

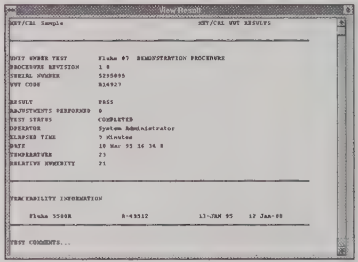
To gain maximum benefit from Fluke's MET/CAL Calibration Software or 5500/CAL, we recommend the following system configurations:

| | Recommended | Minimum |
|---|---|---|
| **Processor** | 33 MHz 80486 | 33 MHz 80386 |
| **Monitor** | SVGA | VGA |
| **Random Access Memory** | 8 MB RAM | 4 MB RAM |
| **Operating System** | Windows 3.1 or later | Windows 3.1 or later |
| **Hard disk space available for programs and data** | 25 MB | 10 MB |
| **IEEE interface (not required for 5500/CAL)** | 2 Ziatech ZT 1444 (included in MET/CAL-K) | 1 Ziatech ZT 1444 |



```
STEP   FSC   RANGE NOMINAL       TOLERANCE     MOD1          MOD2  3  4 CON
 1.001 ASK-  P     N             F                           F        Q
 1.002 ASK+          K                          X
 1.003 HEAD        PRELIMINARY INSTRUCTIONS
 1.004 DISP        [32]                      WARNING
 1.004 DISP        HIGH VOLTAGE is used or exposed during the performance
 1.004 DISP        of this calibration. DEATH ON CONTACT may result if
 1.004 DISP        personnel fail to observe safety precautions.
 1.005 RSLT        =DISPLAY TEST
 1.006 PICE        87_DSP
 2.001 DISP        Rotate the rotary switch to OFF.
 2.002 HEAD        {AC VOLTAGE TESTS}
 2.003 PIC         55_87_2W
 2.004 DISP        Rotate the UUT function switch to VAC.
 2.005 HEAD        AC VOLTAGE TESTS: (400mV Range)
 2.006 ASK+        N 6
 2.007 5500  400   350.0mV       -2.8U +2.9U   60H           S1       2W
 3.001 ASK-        N 6
 3.002 5500  400   350.0mV       3.9U          5kH           S1       2W
 4.001 ASK+          K                                       A
 4.002 5500  400   350.0mV       7.4U          20kH          S1       2W
 5.001 HEAD        {DC VOLTAGE TESTS}
 5.002 DISP        Press the RANGE button and hold it momentarily to
 5.002 DISP        to select Autorange.
 5.003 HEAD        DC VOLTAGE TESTS: (4V Range)
 5.004 5500  4     3.500V        0.005U                               2W
 6.001 HEAD        DC VOLTAGE TESTS: (40V Range)
 6.002 5500  40    35.00V        0.050                                2W
```

Procedures are written in plain language and follow manual calibration steps. Complete procedure listings help satisfy calibration procedure requirements of ISO 9001, 4.11c. More than 300 procedures are included to calibrate a wide variety of instruments. You can further customize procedures or use them as templates for creating new ones.



```
MET/CAL Sample                               MET/CAL UUT RESULTS

UNIT UNDER TEST          Fluke 87  DEMONSTRATION PROCEDURE
PROCEDURE REVISION       1.0
SERIAL NUMBER            5295095
UUT CODE                 A14927

RESULT                   PASS
ADJUSTMENTS PERFORMED    0
TEST STATUS              COMPLETED
OPERATOR                 System Administrator
ELAPSED TIME             3 Minutes
DATE                     10 Mar 95 16 34 8
TEMPERATURE              23
RELATIVE HUMIDITY        21

TRACEABILITY INFORMATION

    Fluke 5500A            A-43512            13-JAN 95    12 Jan-00

TEST COMMENTS...
```

MET/CAL captures complete calibration results, including traceability data and environmental conditions. The operator can see at a glance which tests were performed and which ones passed or failed. Complete results records help you identify out-of-tolerance conditions and satisfy calibration records requirements of ISO 9000.

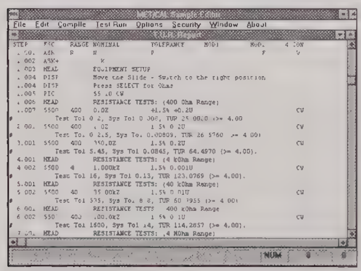
### Literature Available

Fluke Calibration Management Software Brochure
MET/CAL Sample Version Software

### Supported Instruments

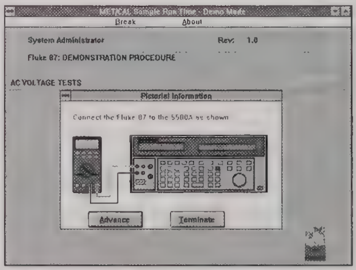
MET/CAL includes drivers to support the following calibration instrumentation:

- 5500A Multi-Product Calibrator
- 5130A Calibration Workstation
- 5700A Calibrator, -03 Wideband option, 5725A Amplifier
- 5790A AC Measurement Standard
- 5100B Series Calibrators, -03 Wideband option
- 5200A Calibrator
- 5205A, 5215A, 5220A Amplifiers
- 5440B Series Calibrators
- 5450A Calibrator
- Fluke 45 Dual Display Multimeter
- 6060B Series RF Signal Generators (6080 Series with emulation)
- 8502A, 8505A, 8506A Multimeters
- 8840 Series Multimeters
- 8920 Series Multimeters (with 1120A)
- Tek CG 5011 and CG 5001 Oscilloscope Calibrators
- Tek SG 5030 Leveled Sinewave Generator
- PM 5191 Function Generator
- PM 5192 Function Generator
- PM 5193 Function Generator
- PM 6666 Counter
- PM 6680 Counter
- HP 3458A Multimeter
- HP 6060B Programmable Load
- HP 6063B Programmable Load



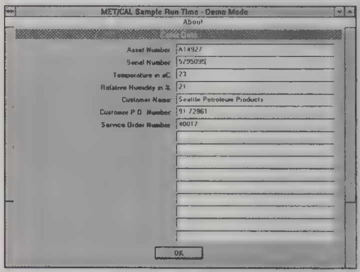
```
STEP   FSC   RANGE NOMINAL       TOLERANCE     MOD1          MOD2     4 CON
 1.001 ASK   R     N             P                           F        V
 1.002 ASK+          K
 1.003 HEAD        EQUIPMENT SETUP
 1.004 DISP        Move the Slide - Switch to the right position
 1.004 DISP        Press SELECT for Ohms
 1.005 PIC         55 10 CW
 1.006 HEAD        RESISTANCE TESTS: (400 Ohm Range)
 1.007 5500  400   0.0Z          +1.5% +0.2U                              CV
#           Test Tol 0 2, Sys Tol 0 008, TUR 25 0000 (>= 4.00
 2 001 5500  400   1.0Z          1 5% 0 2U                                CV
#           Test Tol 0 2.5, Sys Tol 0.00809, TUR 26 5760 >= 4 00)
 3.001 5500  400   350.0Z        1.5% 0.2U                                CV
#           Test Tol 5.45, Sys Tol 0.0845, TUR 64.4970 (>= 4.00).
 4.001 HEAD        RESISTANCE TESTS: (4 kOhm Range)
 4 002 5500  4     1.000kZ       1.5% 0.001U                              CV
#           Test Tol 16, Sys Tol 0.13, TUR 123.0769 (>= 4.00).
 5.001 HEAD        RESISTANCE TESTS: (40 kOhm Range)
 5 002 5500  40    35 00kZ       1.5% 0 01U                               CV
#           Test Tol 535, Sys Tol 8 8, TUR 60 7955 (>= 4 00)
 6 001 HEAD        RESISTANCE TESTS  400 kOhm Range
 6 002 5500  400   100.0kZ       1 5% 0 1U                                CV
#           Test Tol 1600, Sys Tol 14, TUR 114.2857 (>= 4.00).
 7 001 HEAD        RESISTANCE TESTS: (4 MOhm Range)
```

MET/CAL enables you to establish minimum test uncertainty ratios (TURs) to assure that tests performed by the calibrator are sufficiently accurate for the instrument being calibrated. Flagging of TURs helps demonstrate adequacy of standards per ISO 9001, 4.11a, d.



System Administrator
Rev: 1.0
Fluke 87: DEMONSTRATION PROCEDURE
AC VOLTAGE TESTS
Connect the Fluke 87 to the 5500A as shown

MET/CAL procedures use a combination of graphics and straight forward instructions to guide operators step-by-step through the calibration. This reduces errors and enables even less experienced technicians to perform complex tests.



Asset Number: A14927
Serial Number: 5295095
Temperature in øC: 23
Relative Humidity in %: 21
Customer Name: Seattle Petroleum Products
Customer P.O. Number: 91 72861
Service Order Number: 40017

MET/CAL prompts for environmental conditions which helps demonstrate environmental control as per ISO 9001, 4.11h.

## MET/CAL Calibration Management Software

### Instrument Procedures included with MET/CAL

**ScopeMeter Test Tools**
Fluke 91
Fluke 92
Fluke 93
Fluke 95
Fluke 96
Fluke 97
Fluke 97AUTO
Fluke 99
**Calibrators**
Fluke 5700A (AC & -03)
**Process Calibrators**
Fluke 701/702 Documenting Process Calibrators
**Data Loggers**
Fluke 2620A Hydra
Fluke 2625A Hydra
Fluke 2640A NetDAQ
Fluke 2645A NetDAQ
**Meters**
Fluke 10/11/12
Fluke 21/23
Fluke 21-2/23-2
Fluke 25/27/37/8025B
Fluke 29/79
Fluke 29-2/79-2
Fluke 31/33
Fluke 37
Fluke 40/41/45
Fluke 73/75/77/78
Fluke 70-2/73-2/75-2/77-2/79-2
Fluke 83/85/87
Fluke 86/88
Fluke 8000A
Fluke 8010A
Fluke 8012A
Fluke 8020B
Fluke 8021B
Fluke 8022B
Fluke 8024B
Fluke 8026B
Fluke 8050A
Fluke 8060A/8062A
Fluke 8062B
Fluke 8840A/8842A
Hewlett-Packard 3457A
Hewlett-Packard 3478A
Keithley 197
Keithley 199
Fluke/Philips PM 2535
Universal Decade Box

**Oscilloscopes**
Philips PM 3050
Philips PM 3055
Philips PM 3065
Philips PM 3070
Philips PM 3082
Philips PM 3084
Philips PM 3092
Philips PM 3094
Philips PM 3335
Philips PM 3350
Philips PM 3355A
Philips PM 3365
Philips PM 3365A
Philips PM 3375A
Philips PM 3380
Philips PM 3382
Philips PM 3382A
Philips PM 3384
Philips PM 3384A
Philips PM 3392
Philips PM 3392A
Philips PM 3394
Philips PM 3394A
**Counters**
Fluke/Philips PM 6685
**Thermometers**
Fluke 51/52
**Misc. Procedures**
**Keithley**
175A
**Tegam**
135A
**Beckman**
225
3060
DM 15XL
AD/30A Clamp Meter
**Simpson**
270
260
**Hewlett-Packard**
E974A
54600
54601
programmable loads
**Tektronix**
Tektronix 2445A
DM251
DM251
465B
2245B
2246B
2247B
2230
2232
TDS320

**ABB Metrawatt MetraHit**
14/15/16
**Metrix**
Mx20
Mx50
Mx51
Mx51EX
Mx52EX
**Soar**
3100
3210
3220
3250
3255
3430
4010
4020
4030
4050
4055
4061A
5030
**Philips**
PM 2518/02
PM 2618/02
PM 2718/08
PM 3065
PM 3070
**Yokogawa**
7534
7544
2455-13
mR 100
mR 1000
HR 1300
HR 2300
HR 2400
LR 4100
LR 8100
2433
2509
2534
**Sanwa**
9600EA
ED-570C
CD-780C
**Advantest**
TR6847
R6341B
**Omega**
CL23
872A
869 RTD
501/502/503
**Rochester**
CL-4025

**Barnant**
600-2810
**Amprobe**
RS-3
ACD-10
**A.W. Sperry**
DSA-440T
DSA-2007
**Simpson**
2865G-24512
10990
**Modutec Series**
300 Type J TC
500 Type J TC
**Extech**
V3050W
V3060AI
**Rustrack**
Ranger II
**ECD**
5100
SE 00-2650-10
**Norman Goerz**
SE 110/111/111-2-NPI
SE 120
SERVOGOR 124
SERVOGOR 400
SE 790
**Graphtec**
WX 1000
WX 1100
WX 1200
WX 3000
WX 4000
**Soltec**
TA200-839
RTD for TA200-839
TA200-938
A11 for TA200-938
A21 for TA-200-939
TJ1 for TA200-940
1243
DCV for 1243
T,TC for 1243
RTD for 1243
**Gould**
220 line NPI
2000 line NPI
TA 240 PI
TA 4000 PI
TA 5000 PI

**Astro-Med**
MT-95 K2 PI
AWP-1 for MT-95
AWP-2 for MT-95
Dash 2
Med Dash 4
PM 02 for Dash 4
PM 03 for Dash 4
T,TC for Dash 4
Dash 8
**Graphtec**
WR3310
WR7700
WR8000
Mark 12
**AEMC**
1800
AEMC 3900
AEMC 3930
**Valhalla**
2101
2100
**BMI**
PowerVisa 100G
155
**Angus Electric**
S23171
**Promac**
DHT830
D1-H-740
**Transmation**
1045
1074
**Beta**
230

## Ordering Information

**MET/CAL-4** Calibration Software ***$4995***
**MET/CAL-K4** Calibration Software with IEEE interfaces ***$5995***
**MET/CAL-U4** Upgrade from previous version ***$995***
**MET/CAL-U4 K** Upgrade from previous version with IEEE interfaces ***$1995***
**5500/CAL** RS-232 Calibration Software for the 5500A Multi-Product Calibrator ***$2500***

# Calibration Software

## MET/TRACK Metrology Asset Management Software

Coming – Industry Standard
SQL Database
Client/Server Architecture

Designed precisely for measurement asset management

Supports requirements of ISO 9000 and related standards

Reports forward and reverse traceability

MET/TRACK is a specialized data management system for measurement assets. It is structured around the flow of measurements through the calibration recall and testing process. Multiple, linked data bases store information about calibration, repair and location history, standards used and more. Data can be entered manually or imported from other systems or applications like Fluke's MET/CAL calibration software. Data validation assures accuracy and consistency. More than 90 report formats are included covering a wide range of metrology and quality information needs. MET/TRACK can be run on a single workstation or over any local area network that supports Microsoft Windows.®

### Designed Specifically for Measurement Quality Management

Because it was created specifically to manage equipment in the calibration environment, MET/TRACK gives you flexibility and power not available in generic database applications. It enables you to track the information you need to maintain quality calibrations and supports the traceability and recordkeeping requirements of modern quality standards, including ISO 9000 and MIL-STD-45662A.

### With MET/TRACK you can:

- Identify and assign calibration workload
- Measure technician productivity
- Schedule work
- Report on traceability to and from national standards
- Track and control repair and calibration turn-around time
- Report on overdue backlog
- Log total calibration and repair orders by user and technician
- Locate and track measurement assets
- Maintain equipment acquisition, depreciation, and ownership costs
- Identify reliability problems or extend calibration intervals

And, because you maintain local control of your inventory, you can get the data you need when you need it, rather than having to depend on corporate mainframe systems.

### Literature available

Fluke Calibration Management Software Brochure.
MET/TRACK Sample Version Software.

### Recommended System Configuration

To gain maximum benefit from Fluke's Calibration and Inventory Management Software we recommend the following system configuration:

| | Minimum | Recommended |
|---|---|---|
| Processor | 33 MHz 80386 | 33 MHz 80486 |
| Monitor | VGA | SVGA |
| Random Access Memory | 4 MB RAM | 8 MB RAM |
| Operating System | Windows 3.1 or later | Windows 3.1 or later |
| Hard disk space available for programs and data | 20 MB | 100 MB |
| IEEE interface (not required for 5500/CAL) | | |
| Other | | Tape back-up drive |

### Training

Attending a five-day training course on MET/CAL or MET/TRACK is a great way for users to realize the full potential of these applications. The MET/CAL training course covers daily use and procedure writing. The MET/TRACK training course helps you plan your inventory management system and customize it to meet your needs.

Fluke also offers classes in Principles of Metrology, The Basics of DC and Low Frequency AC Calibration, and Calibration Laboratory Management. For further information and course schedules, contact your local Fluke representative.

## Ordering Information

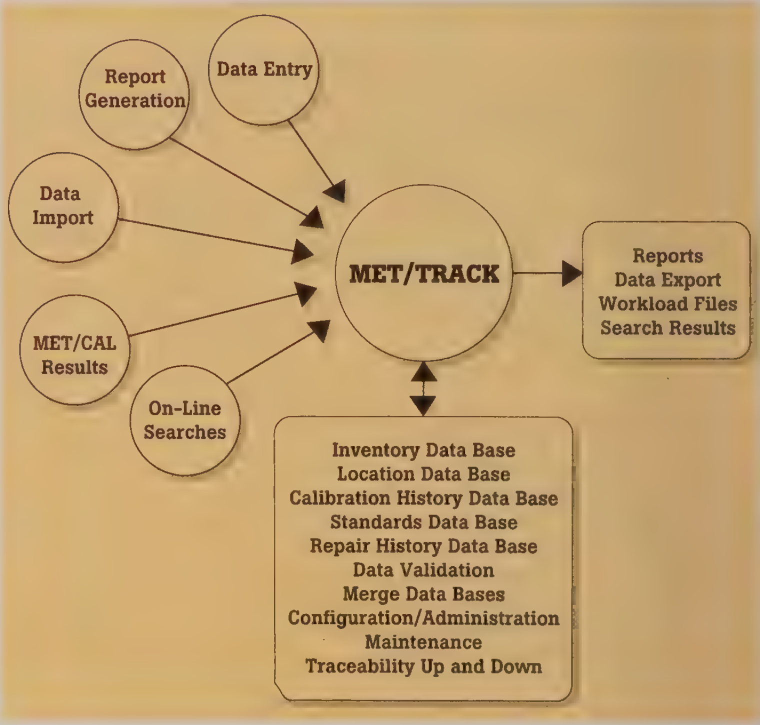
### Models

**MET/TRACK-4** Metrology Asset Management Software *$2495*

**MET/TRACK-U4** Upgrade From Previous Versions *$995*

**MET/TRACK-ND4** Metrology Management Software Node *$950*

**MET/TRACK-KU4** MET/TRACK Key Upgrade *$95*



# Standards Instruments

## 734A Reference and Transfer Standards

Four independent 10V and 1.018V outputs

Meets the requirements of NBS 1239

Small, rugged, 72 hour battery life

Supports 5700A Artifact Calibration

734A DC REFERENCE STANDARD
732B DC STANDARD
732B DC STANDARD
732B DC STANDARD
732B DC STANDARD
10V COM
1.018V COM
GUARD

The 732B is a direct voltage standard with 10V and 1.018V outputs. The 734A is a direct voltage reference standard that consists of four 732Bs that are mechanically and electrically isolated housed in a rack-mountable enclosure.

The 734A is designed to be a primary voltage standard for primary and secondary calibration and standard laboratories. Because it is made up of four independent standards, intercomparisons of the standards and statistical methods can be used to reduce the uncertainty of the reference significantly over time.

Because each 732B is independent, it can be removed from the 734A and used as a portable standard to transfer a value from the primary 734A reference to remote service or production locations for traceability, without disturbing the primary reference.

The 734A is the only standard of its type that meets the design requirements of Technical Note NBS 1239, published by the U.S. National Institute of Standards and Technology in 1987.

### Key Benefits

The 732B is based on the proven technology of the Fluke 732A, the first standards lab quality electronic reference to gain acceptance as a replacement for saturated standard cells.

Stability for each output is ±2 ppm per year (10V) and ±0.8 ppm per month (1.018V). Each 10V output can drive up to 12 mA of current to simplify use with instrumentation — like the 5700A — with low output impedance.

With the 734A, it is remarkably easy to establish a fractional part-per-million voltage reference in your laboratory. Over time, with frequent intercomparisons of the four cells, and regular calibrations of one or more cells, you can reduce the uncertainty of your 734A by a factor of 3 or more.

Each standard is small, light and rugged, ideal for shipment. The long 72 hour battery life allow the 732B to be shipped over long distances under power. An optional external battery and charger extends battery life still further, to more than 130 hours.

The 732B can stand up to a lot of abuse. The inputs can be shorted indefinitely and are protected up to 1100V dc, 25 mA, without damaging the cell or affecting its output.

Combined with the Fluke 742A-1 and 742A-10k Resistance Standards, a single 732B makes a tough and compact artifact calibration support package for instruments like the 5700A Calibrator from Fluke or the 3458A Multimeter from Hewlett Packard. (Just such a package is available. See the 5700A-7002.)

## Specifications

### Technical Specifications

**Absolute Uncertainty:** The 734A and 732B are normally delivered without absolute uncertainty specifications because, to maintain traceability they must continue to receive uninterrupted operating voltage from the ac power lines or from the internal batteries. The 734A is normally shipped from the factory with the battery switches turned off. Upon receipt, the 734A must be powered up and allowed to stabilize for 24 hours before calibration against traceable standards. The absolute uncertainty specification for the standards must be related to the uncertainty specifications for the traceable standards used for calibration. For certified calibrations order options −000 or −100, described under the DVMP in this catalog.

**Stability:** Parts per million, (23 ±1°C)

| Output | 30 Days | 1 Year |
|---|---|---|
| 10V | ±0.3 | ±2.0 |
| 1.018V | ±0.8 | |

**Temperature Coefficient:** ≤ ±0.04 ppm per °C for 10V output, ≤ ±0.1 ppm per °C for 1.018V output, from 15°C to 35°C

**Output Adjustment:** ±2 mV for 10V output, none on the 1.018V output

**Output Impedance:** 1 mΩ for 10V output, 1 kΩ for 1.018V output

**Output Current:** Up to 12 mA for 10V output, limited by 1 kΩ output impedance for 1.018V output

**Output Protection:** May be shorted indefinitely, protected against high voltage input transients to 1100V

**Load Regulation:** ≤0.1 ppm for a load change in the range 0 to 2 mA, ≤1 ppm for a load change in the range 2 to 12 mA for the 10V output

**Line Regulation:** ≤0.05 ppm of output for a ±10% line change

## 734A Reference and Transfer Standards

### General Specifications

**Temperature:** 15°C to 35°C, operating; −51°C to 71°C, non-operating (with internal battery pack switched off)
**Relative Humidity:** ≤95% to 30°C, ≤75% to 35°C, non-condensing
**Altitude:** ≤3049m (10,000 ft) operating, ≤12,195m (40,000 ft) non-operating
**Vibration:** Per MIL-T-28800; Type III, Class 5, Style E
**Safety:** Designed to IEC 348, 2nd edition; 1978 and ANSI/ISA-S82; and UL1244, 2nd edition 1980, CSA C22.2 No 231, and IEC 1010

**734A DC Reference Standard**
**Size:** 17.8 cm H × 43.2 cm W × 43.6 cm D (7 in H × 17 in W × 19.8 in D) (with handles)
**Weight:** 29 kg (65 lb)

**732B DC Standard**
**Power:** 100V, 120V, 220V, 240V ac ±10%; 50 Hz to 60 Hz; 66W max. Internal 12V lead acid, gelled electrolyte battery operates for 70 hours at 23°C when fully charged. Trickle-charged continually when external ac power is applied.
**Size:** 13.1 cm H × 9.6 cm W × 40.6 cm D (5.16 in H × 3.78 in W × 15.98 in D)
**Weight:** 5.91 kg (13 lb)

**732B-7001 External Battery and Charger**
**Power:** 100V, 120V, 220V, 240V ac ±10%; 50 Hz to 60 Hz; 66W max. Internal 12V lead acid, gelled electrolyte battery operates for 70 hours at 23°C when fully charged. Trickle-charged continually when external ac power is applied.
**Size:** 13.1 cm H × 9.6 cm W × 40.6 cm D (5.16 in H × 3.78 in W × 15.98 in D)
**Weight:** 5.45 kg (12 lb)

### Literature Available

734A Data Sheet (A0484)
Fractional PPM Traceability using your 732A (B0196)
Artifact Calibration: Theory and Application (B0218)

## Ordering Information

### Models

**734A** DC Reference Standard ***$14,800***
**732B** DC Standard ***$3990***
**732B-000** 10V Output Voltage Calibration for one 732B, shipped hot* ***Contact Factory***
**732B-000I** 10V Output Voltage Calibration for one 732B for international shipment ***$435***
**732B-100** 10V Output Voltage Calibration and Drift Characterization for one 732B, shipped hot* ***$985***
**732B-100I** 10V Output Voltage Calibration and Drift Rate Characterization for one 732B for international shipment ***Contact Factory***
**732B-200** On-Site 10V Output Voltage Calibration w/Fluke owned standard ***$922***
**732B-201** Calibration of additional standards at 10V, on-site ***$407***

*Under power

### Accessories

**732B-7001** External Battery and Charger ***$1360***
**732B-7002** Transit Case (1 or 2 732Bs) ***$765***
**734A-7001** Instrument Enclosure ***$1420***
**5440A-7002** Low Thermal EMF Copper Plug-in Cables ***$475***
**Y734** Rack Mount Kit ***$370***

# 5790A AC Measurement Standard

Automated ac measurement with precision that is easy to use

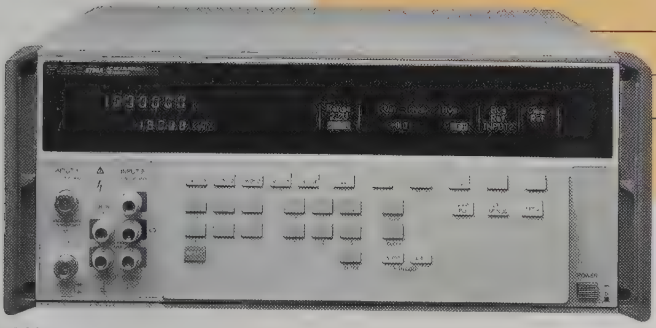
24 ppm total uncertainty

Traceable to national standards

Voltage range 700 µV to 1000V

Frequency range 10 Hz to 1 MHz

Optional wideband to 30 MHz



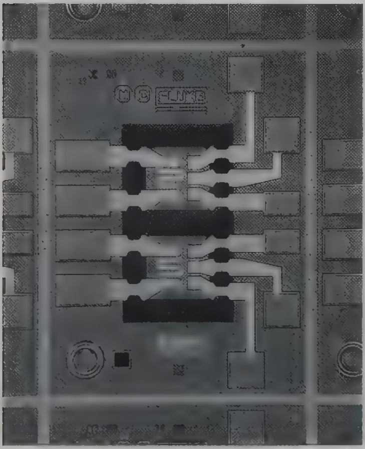
5790A

## Accuracy That's Easy To Use

The 5790A is a complete automated ac measurement standard designed for the most demanding calibration applications. It combines the accuracy you would expect from a thermal transfer standard with the ease-of-use of a digital multimeter. Absolute ac voltage measurement uncertainties are as low as ±24 ppm (one year, 23°C ±5°C). The 5790A is designed to meet the complete ac voltage and wideband verification requirements of the Fluke 5700A, 5500A and other calibrators, amplifiers like the 5725A and 5205A, and transfer standards and ac voltmeters.

The 5790A covers an alternating voltage range of 700 µV to 1000V, and a frequency range of 10 Hz to 1 MHz. A wideband voltage option extends frequency range to 30 MHz to meet the calibration requirements of Fluke 5700A and 5100 Series calibrators.

The 5790A is also compatible with Fluke A40 and A40A Current Shunts, which permit you to make ac/dc current transfer measurements up to 20A.



The patented Fluke Solid-State RMS Sensor provides the 5790A with exceptional accuracy and stability, and fast settling time.

The 5790A may be used alone or as a transfer standard with an external dc source. In either case the normally tedious switching and calculations are performed automatically by the 5790A, and the resulting ac/dc difference is displayed directly on the easy-to-read vacuum fluorescent display.

## Versatility That Keeps You Productive

When you first power up the 5790A, diagnostics verify the instrument's integrity.

The variety of input connections allows you to use the one that best suits your application. There are four sets of input terminals on the 5790A, two Type-N connectors and two sets of five-way binding posts. One Type-N and one set of binding posts are dedicated to the ac measurement and transfer modes. AC or dc voltages may be applied to either input connection over the 5790's full range, allowing you to perform automated ac/dc transfer measurements. The 5790A determines automatically whether the applied voltage is ac or dc.

The second Type-N input connection supports the optional wideband mode, and the second set of binding posts are designed for Fluke A40 Series Current Shunts.

The input connection is selected with the touch of a key on the 5790A front panel. An LED indicates which selection is active.

Whether you are using the 5790A as a voltmeter or a transfer standard, input voltage and frequency are always indicated on the measurement display. In the transfer mode, the ac/dc or ac/ac difference is always indicated on the control display in ppm, %, volts or ratio.

The 5790A is a fully autoranging instrument and selects the best voltage range for the measurement you are making. You may also select and lock in ranges manually. Robust 1200V input protection is active on all voltage ranges.

Using the trigger keys, the 5790A can switch from continuous to single measurements of the input voltage, making it easy to take sample readings at predetermined intervals.

When using the 5790A in transfer mode, the reference voltage is stored automatically, and all ac/dc or ac/ac difference measurements are made relative to it. At any time, you can view the reference by pressing the VIEW REF key. You may also store the average of two voltages as a reference to eliminate dc reversal errors, for example.

The intuitive front panel layout of the 5790A makes manual operation fast and simple. Keys and selections are logically arranged and labelled. And messages and menus are displayed clearly on the 5790A's bright, vacuum fluorescent display.

The 5790A is at home in automated systems as well. GPIB/IEEE-488* and RS-232C interfaces are included and all functions of the instruments can be controlled by a variety of host computers, including PCs. Using an available instrument driver, the 5790A can be integrated into automated systems operating under MET/CAL™ Calibration Software.

## Designed With Your Support Requirements in Mind

The 5790A provides a self-contained calibration procedure designed to simplify periodic performance verification. The operator is prompted on what actions to take. To minimize the equipment required, the 5790A is designed to be supported by the Fluke 792A AC/DC Transfer Standard.

# 5790A AC Measurement Standard

## Specifications

### General Specifications

**Warm-up Time:** 30 minutes

**Relative Humidity**

**Operating:** 45% to 50°C; 75% to 45°C; 95% to 30°C

**Storage:** <95% non-condensing

**Altitude**

**Operating:** 3,050 meters (10,000 feet)

**Non-Operating:** 12,200 meters (40,000 feet)

**Temperature**

**Operating:** 0°C to 50°C

**Calibration:** 15°C to 35°C

**Storage:** −40°C to 70°C

**EMI/RFI:** Complies with FCC Part 15 Subpart B, Class B; VDE 0871, Class B; ESD: EIA PN-1361. Surge: ANSI C62.41-1980, Category A

**Reliability:** MIL-T-28800D, paragraph 3.13.3

**Line Power:** 47 Hz to 63 Hz; ±10% of selectable line voltages: 100V, 110V, 115V, 120V, 200V, 220V, 230V, 240V

**Safety:** Complies with UL 1244 and IEC348-1978 and IEC 1010 and CSA C22.2 No. 231

**Remote Interfaces:** RS-232C, IEEE-488

**Size**

**Height:** 17.8 cm (7 in) standard rack mount +1.5 cm (0.6 in)

**Width:** 43.2 cm (17 in)

**Depth:** 63 cm (24.8 in)

**Maximum Power:** 5790A: 95 VA; with wideband: 120 VA

**Weight:** 5790A: 24 kg (53 lb); with wideband: 24.5 kg (54 lb)

### Literature Available

5790A Data Sheet (A0415)

Design and Development App Note (B0219A)

### Summary Specs

| Range | Frequency Hz | Absolute Uncertainty | | |
|---|---|---|---|---|
| | | Measurement Mode ±5 Degrees C from calibration temperature | | |
| | | 90 Days | 1 year | 2 years |
| | | ± (ppm output + µV) | | |
| 2.2 mV | 10 Hz - 20 Hz | 1700 + 1.3 | 1700 + 1.3 | 1700 + 1.3 |
| | 20 Hz - 40 Hz | 740 + 1.3 | 740 + 1.3 | 740 + 1.3 |
| | 40 Hz - 20 kHz | 420 + 1.3 | 420 + 1.3 | 420 + 1.3 |
| | 20 kHz - 50 kHz | 810 + 2.0 | 810 + 2.0 | 820 + 2.0 |
| | 50 kHz -100 kHz | 1200 + 2.5 | 1200 + 2.5 | 1200 + 2.5 |
| | 100 kHz - 300 kHz | 2300 + 4.0 | 2300 + 4.0 | 2300 + 4.0 |
| | 300 kHz - 500 kHz | 2400 + 6.0 | 2400 + 8.0 | 2600 + 8.0 |
| | 500 kHz - 1 MHz | 3200 + 6.0 | 3500 + 8.0 | 5000 + 8.0 |
| 7 mV | 10 Hz - 20 Hz | 850 + 1.3 | 850 + 1.3 | 850 + 1.3 |
| | 20 Hz - 40 Hz | 370 + 1.3 | 370 + 1.3 | 370 + 1.3 |
| | 40 Hz - 20 kHz | 210 + 1.3 | 210 + 1.3 | 210 + 1.3 |
| | 20 kHz - 50 kHz | 400 + 2.0 | 400 + 2.0 | 410 + 2.0 |
| | 50 kHz - 100 kHz | 600 + 2.5 | 600 + 2.5 | 610 + 2.5 |
| | 100 kHz - 300 kHz | 1200 + 4.0 | 1200 + 4.0 | 1200 + 4.0 |
| | 300 kHz - 500 kHz | 1300 + 6.0 | 1300 + 8.0 | 1400 + 8.0 |
| | 500 kHz - 1 MHz | 2000 + 6.0 | 2300 + 8.0 | 3600 + 8.0 |
| 22 mV | 10 Hz - 20 Hz | 290 + 1.3 | 290 + 1.3 | 290 + 1.3 |
| | 20 Hz - 40 Hz | 180 + 1.3 | 190 + 1.3 | 190 + 1.3 |
| | 40 Hz - 20 kHz | 110 + 1.3 | 110 + 1.3 | 110 + 1.3 |
| | 20 kHz - 50 kHz | 210 + 2.0 | 210 + 2.0 | 210 + 2.0 |
| | 50 kHz - 100 kHz | 310 + 2.5 | 310 + 2.5 | 310 + 2.5 |
| | 100 kHz - 300 kHz | 810 + 4.0 | 810 + 4.0 | 820 + 4.0 |
| | 300 kHz - 500 kHz | 860 + 6.0 | 890 + 8.0 | 1000 + 8.0 |
| | 500 kHz - 1 MHz | 1400 + 6.0 | 1700 + 8.0 | 2600 + 8.0 |
| 70 mV | 10 Hz - 20 Hz | 240 + 1.5 | 240 + 1.5 | 240 + 1.5 |
| | 20 Hz - 40 Hz | 120 + 1.5 | 120 + 1.5 | 130 + 1.5 |
| | 40 Hz - 20 kHz | 64 + 1.5 | 65 + 1.5 | 69 + 1.5 |
| | 20 kHz - 50 kHz | 120 + 2.0 | 130 + 2.0 | 130 + 2.0 |
| | 50 kHz - 100 kHz | 260 + 2.5 | 260 + 2.5 | 260 + 2.5 |
| | 100 kHz - 300 kHz | 510 + 4.0 | 510 + 4.0 | 530 + 4.0 |
| | 300 kHz - 500 kHz | 660 + 6.0 | 670 + 8.0 | 680 + 8.0 |
| | 500 kHz - 1 MHz | 1100 + 6.0 | 1100 + 8.0 | 1300 + 8.0 |
| 220 mV | 10 Hz - 20 Hz | 210 + 1.5 | 210 + 1.5 | 210 + 1.5 |
| | 20 Hz - 40 Hz | 84 + 1.5 | 85 + 1.5 | 87 + 1.5 |
| | 40 Hz - 20 kHz | 37 + 1.5 | 38 + 1.5 | 43 + 1.5 |
| | 20 kHz - 50 kHz | 69 + 2.0 | 69 + 2.0 | 73 + 2.0 |
| | 50 kHz - 100 kHz | 160 + 2.5 | 160 + 2.5 | 160 + 2.5 |
| | 100 kHz - 300 kHz | 240 + 4.0 | 250 + 4.0 | 280 + 4.0 |
| | 300 kHz - 500 kHz | 360 + 6.0 | 380 + 8.0 | 400 + 8.0 |
| | 500 kHz - 1 MHz | 940 + 6.0 | 1000 + 8.0 | 1200 + 8.0 |
| 700 mV | 10 Hz - 20 Hz | 210 + 1.5 | 210 + 1.5 | 210 + 1.5 |
| | 20 Hz - 40 Hz | 75 + 1.5 | 76 + 1.5 | 78 + 1.5 |
| | 40 Hz - 20 kHz | 31 + 1.5 | 33 + 1.5 | 38 + 1.5 |
| | 20 kHz - 50 kHz | 50 + 2.0 | 51 + 2.0 | 56 + 2.0 |
| | 50 kHz - 100 kHz | 79 + 2.5 | 79 + 2.5 | 84 + 2.5 |
| | 100 kHz - 300 kHz | 160 + 4.0 | 180 + 4.0 | 210 + 4.0 |
| | 300 kHz - 500 kHz | 300 + 6.0 | 300 + 8.0 | 340 + 8.0 |
| | 500 kHz - 1 MHz | 900 + 6.0 | 960 + 8.0 | 1200 + 8.0 |

# Standards Instruments

## 5790A AC Measurement Standard

| Range | Frequency Hz | Absolute Uncertainty | | |
|---|---|---|---|---|
| | | Measurement Mode | | |
| | | 90 Days | 1 year | 2 years |
| | | ± (ppm of Reading) | | |
| 2.2V | 10 Hz - 20 Hz | 200 | 200 | 200 |
| | 20 Hz - 40 Hz | 65 | 66 | 69 |
| | 40 Hz - 20 kHz | 22 | 24 | 29 |
| | 20 kHz - 50 kHz | 45 | 46 | 52 |
| | 50 kHz - 100 kHz | 70 | 71 | 76 |
| | 100 kHz - 300 kHz | 150 | 160 | 200 |
| | 300 kHz - 500 kHz | 250 | 260 | 310 |
| | 500 kHz - 1 MHz | 840 | 900 | 1200 |
| 7V | 10 Hz - 20 Hz | 200 | 200 | 200 |
| | 20 Hz - 40 Hz | 66 | 67 | 70 |
| | 40 Hz - 20 kHz | 22 | 24 | 29 |
| | 20 kHz - 50 kHz | 46 | 48 | 53 |
| | 50 kHz - 100 kHz | 80 | 81 | 88 |
| | 100 kHz - 300 kHz | 180 | 190 | 220 |
| | 300 kHz - 500 kHz | 380 | 400 | 470 |
| | 500 kHz - 1 MHz | 1100 | 1200 | 1500 |
| 22V | 10 Hz - 20 Hz | 200 | 200 | 200 |
| | 20 Hz - 40 Hz | 66 | 67 | 70 |
| | 40 Hz - 20 kHz | 25 | 27 | 31 |
| | 20 kHz - 50 kHz | 46 | 48 | 53 |
| | 50 kHz - 100 kHz | 80 | 81 | 85 |
| | 100 kHz - 300 kHz | 180 | 190 | 220 |
| | 300 kHz - 500 kHz | 380 | 400 | 470 |
| | 500 kHz - 1 MHz | 1100 | 1200 | 1500 |
| 70V | 10 Hz - 20 Hz | 200 | 200 | 200 |
| | 20 Hz - 40 Hz | 67 | 68 | 72 |
| | 40 Hz - 20 kHz | 30 | 32 | 39 |
| | 20 kHz - 50 kHz | 56 | 57 | 63 |
| | 50 kHz - 100 kHz | 91 | 94 | 110 |
| | 100 kHz - 300 kHz | 190 | 200 | 220 |
| | 300 kHz - 500 kHz | 400 | 410 | 510 |
| | 500 kHz - 1 MHz | 1100 | 1200 | 1500 |
| 220V | 10 Hz - 20 Hz | 200 | 200 | 200 |
| | 20 Hz - 40 Hz | 67 | 68 | 72 |
| | 40 Hz - 20 kHz | 29 | 31 | 38 |
| | 20 kHz - 50 kHz | 67 | 69 | 77 |
| | 50 kHz - 100 kHz | 96 | 98 | 110 |
| | 100 kHz - 300 kHz | 210 | 210 | 260 |
| | 300 kHz - 500 kHz | 440 | 500 | 700 |
| 700V | 10 Hz - 20 Hz | 200 | 200 | 200 |
| | 20 Hz - 40 Hz | 96 | 99 | 110 |
| | 40 Hz - 20 kHz | 39 | 41 | 47 |
| | 20 kHz - 50 kHz | 120 | 130 | 150 |
| | 50 kHz - 100 kHz | 400 | 500 | 850 |
| 1000V | 10 Hz - 20 Hz | 200 | 200 | 200 |
| | 20 Hz -40 Hz | 96 | 99 | 110 |
| | 40 Hz - 20 kHz | 37 | 38 | 44 |
| | 20 kHz - 50 kHz | 120 | 130 | 150 |
| | 50 kHz - 100 kHz | 400 | 500 | 850 |

Traceability to national standards for the 5790A is supported through the Fluke 792A.

## Ordering Information

### Model

**5790A** AC Measurement Standard *$16,950*

### Option

**5790A-03** Wideband AC Measurement *$4255*

### Accessories

**5440A-7002** Low Thermal Cable Set *$475*

**792A-7003** Transfer Switch *$1575*

**792A-7004** A40 Current Shunt Adapter. Connects directly to Type-N input connector to permit use with A40 Current Shunts. *$880*

**A45-4004** Output Cable for A40A Current Shunts. Connects the output of A40A to 792A-7004 Adapter. *$175*

**A40** Current Shunts (10, 20, 50, 100, 200, 300, 500 mA and 1, 2, 3, 5A). Requires 792A-7004. *$985*

**A40A** Current Shunts (10 and 20A). Requires 792A-7004 and A45-4004. *$1100*

**Y5737** 5790A Rack Mount Kit. Includes 24" slides that allow for side ventilation. *$450*

**Y8021** Shielded IEEE-488 Cable, 1m *$195*

**Y8022** Shielded IEEE-488 Cable, 2m *$210*

**Y8023** Shielded IEEE-488 Cable, 4m *$220*

### Customer Support Services

**Factory Warranty**

One-year product warranty.

# 792A AC/DC Transfer Standard

- 10 ppm total uncertainty
- Traceable to national standards
- Voltage range 2 mV to 1000V
- Frequency range 10 Hz to 1 MHz
- Fast and easy to use

792A

## Description

The 792A consists of four units.

The Transfer Unit is the main analog component of the 792A for the 20 mV to 220V ranges. Stainless Steel Type-N connectors assure low signal loss and high measurement repeatability. The separate Power Pack unit permits the Transfer Unit and 1000V Range Resistor to be shipped independently for calibration. The 1000V Range Resistor isolates the heat generated at high voltages outside the main Transfer Unit. The Range Resistor has a low temperature coefficient, stabilizes quickly and exhibits small ac/dc differences. The Transfer Switch provides for switching between the ac and dc inputs.

Each 792A is shipped from the factory traceable to NIST standards. Each 792A also includes a table of correction factors and uncertainties for measured ac/dc differences.

Fluke A40 and A40A support ac current transfer measurements. An optional 792A-7004 Adapter is required.

## Specifications

### General Specifications

**Temperature Stabilization:** Allow 12 hours stabilization time in the environment of use

**Warm-Up Time:** 15 minutes with power on, after stabilization time

**Temperature Performance:** Operating: 11°C to 35°C; calibration: 18°C to 28°C; storage: −40°C to 50°C

**Relative Humidity:** Operating: <75% to 30°C, <70% to 35°C; storage: <95%, non-condensing

**Altitude:** Operating: to 3,050 m (10,000 ft); non-operating: to 12,200 m (40,000 ft)

**Safety:** Designed to comply with UL 1244 (1987); IEC 348-1978; IEC 1010; CSA 556B and ANSI/ISA 582

**Input Low Isolation:** 20V to chassis

**Guard Isolation:** 10V to input LO or chassis

**EMI/RFI:** Designed to comply with FCC Rules Part 15, Subpart J, Class B; VDE 0871, Class B; VDE 0875, Class K

**Reliability:** MIL-STD-28800D, para 3.13.3

**Line Power:** 50 Hz to 60 Hz ±5% allowed about selectable nominal line voltages: 100V, 120V, 220V, 240V ±10%; maximum power: 45 VA

**Size**

**Transfer Unit:** 17.8 cm H × 21.6 cm W × 30.5 cm D (7 in H × 8.5 in W × 12 in D)

**Power Pack:** 17.8 cm H × 21.6 cm W × 30.5 cm D (7 in H × 8.5 in W × 12 in D)

**1000V Range Resistor:** 7.6 cm H × 8.9 cm W × 14.0 cm D (3 in H × 3.5 in W × 5.5 in D)

**Transfer Switch:** 7.6 cm H × 8.9 cm W × 14.0 cm D (3 in H × 3.5 in W × 5.5 in D)

**Weight**

**Transfer Unit:** 8.4 kg (18.5 lb)

**Power Pack:** 8.9 kg (19.5 lb)

**1000V Range Resistor:** 1.6 kg (3.5 lb)

**Transfer Switch:** 1.6 kg (3.5 lb)

### Literature Available

792A Data Sheet (A0394)

Establishing Traceablility for a High Performance AC/DC Transfer Standard (B0205A)

### Summary Specs

| Function | Range |
|---|---|
| Voltage | 2 mV - 1000V |
| Frequency | 10 Hz - 1 MHz |
| Best AC/DC Difference Uncertainty | ± 10 ppm per year (Traceable to NIST) |

## Ordering Information

### Model

**792A** AC/DC Transfer Standard ***$24,950***

### Included with Instrument

Transfer Unit, Power Pack, 1000V Range Resistor, Transfer Switch, Instruction manual and Report of Calibration.

### Accessories

**792A-7001** Power Pack ***$3305***

**792A-7002** 1000V Range Resistor ***$2400***

**792A-7003** Transfer Switch ***$1575***

**792A-7004** A40 Current Shunt Adapter ***$880***

**A45-4004** Output cable for A40A current shunts connects the output of the A40A to the 792A-7004 adaptor ***$175***

*No charge with purchase of unit

### Customer Support Services

**Factory Warranty**

One-year product warranty.

## 742A Resistance Standards

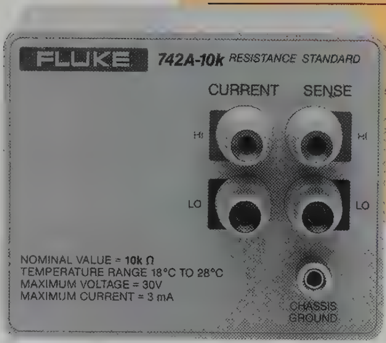
Small and rugged

No oil or air baths required

18°C to 28°C operating range

Supplied with temperature characterization

Six-month stability to 2.5 ppm



Fluke 742A Resistance Standards are high accuracy working standards for precision, on-site resistance calibration. Their excellent temperature stability allows them to be used from 18°C to 28°C with typically less than 2 ppm degradation. Using the calibration table supplied with the standards, which lists corrections in 0.5°C increments, this uncertainty can be reduced to near zero. No cumbersome oil or air baths are required.

Because 742A Resistance Standards are small and rugged, they are easy to transport. Care has been taken to reduce resistance changes brought about by thermal and mechanical shock. Retrace (permanent shift in resistance) is typically less than 2 ppm after cycling between 0°C and 40°C.

The 742A-1 1Ω and the 742A-10k 10 kΩ units are ideally suited for Artifact Calibration of the Fluke 5700A Calibrator. The other values can be used to verify the calibration if you desire.

A convenient transit case, designed to hold two standards, is available as an option.

## Specifications

| Model | Nominal Value ±2 ppm (Ohms) | Stability | | Calibration Uncertainty 23°C (PPM) | Max Change 18-28°C (± PPM) | Max Voltage (Volts) |
|---|---|---|---|---|---|---|
| | | 6 Month (PPM) | 12 Month (PPM) | | | |
| 742A-1 | 1.0 | 5.0 | 8.0 | 1.0 | 3.0 | 0.5 |
| 742A-1.9 | 1.9 | 5.0 | 8.0 | 1.0 | 3.0 | 0.38 |
| 742A-10 | 10.0 | 5.0 | 8.0 | 1.0 | 3.0 | 1.0 |
| 742A-100 | 100.0 | 4.0 | 6.0 | 1.0 | 3.0 | 2.0 |
| 742A-1k | 1.0k | 4.0 | 6.0 | 1.5 | 2.0 | 10.0 |
| 742A-10k | 10.0k | 2.5 | 4.0 | 1.0 | 1.5 | 30.0 |
| 742A-19k | 19.0k | 2.5 | 4.0 | 1.5 | 2.0 | 28.5 |
| 742A-100k | 100.0k | 4.0 | 6.0 | 2.5 | 2.0 | 100.0 |
| 742A-1M | 1.0M | 6.0 | 8.0 | 5.0 | 2.0 | 100.0 |
| 742A-10M | 10.0M | 6.0 | 9.0 | 10.0 | 3.0 | 200.0 |
| 742A-19M | 19.0M | 8.0 | 10.0 | 20.0 | 4.0 | 190.0 |

**Operating Temperature Range:** 18-28°C
**Storage Temperature:** 0-40°C
**Retrace Error (hysteresis):**
23°C-18°C-23°C cycle: Negligible resistance shift
23°C-28°C-23°C cycle: Negligible resistance shift
23°C-0°C-23°C cycle: <2 ppm resistance shift
23°C-40°C-23°C cycle: <2 ppm resistance shift

**Size:** 8.6 cm H × 10.5 cm W × 12.7 cm D (3.4 in H × 4.15 in W × 5 in D)

**Weight:** .68 kg to .91 kg (1.5 lb to 2 lb) depending on the model

### Literature Available

742 Series Data Sheet (A0298)

## Ordering Information

### Models

**742A-1** 1Ω Resistance Standard ***$1575***
**742A-1.9** 1.9Ω Resistance Standard ***$1575***
**742A-10** 10Ω Resistance Standard ***$1575***
**742A-100** 100Ω Resistance Standard ***$1575***
**742A-1k** 1 kΩ Resistance Standard ***$1575***
**742A-10k** 10 kΩ Resistance Standard ***$1575***
**742A-19k** 19 kΩ Resistance Standard ***$1575***
**742A-100k** 100 kΩ Resistance Standard ***$1575***
**742A-1M** 1 MΩ Resistance Standard ***$1575***
**742A-10M** 10 MΩ Resistance Standard ***$1575***
**742A-19M** 19 MΩ Resistance Standard ***$1575***
**742A-7002** Transit Case (holds 2 units) ***$595***

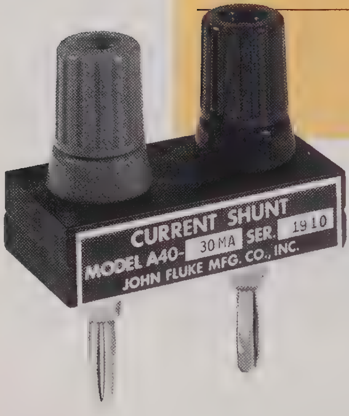
Optional 742A-7002 transit case.

## A40/A40A Current Shunts

AC current transfer measurements from 2.5 mA to 20A

Frequency between 5 Hz to 100 kHz

Compatible with 792A and 5790A



The A40 Series consists of 12 shunts rated from 10 mA up to 5A. The A40A shunts add 10A and 20A ranges.

The A40/A40A allows you to make ac/dc current transfer measurements with the 792A Transfer Standard or 5790A Measurement Standard. Special cables are required.

## Specifications

**A40 Current Ratings:** 10, 20, 30, 50, 100, 200, 300, and 500 mA; 1, 2, 3, and 5A (rms)
**A40A Current Ratings:** 10A and 20A (rms)

**Uncertainty**

| | AC to DC Difference | |
|---|---|---|
| Frequency | A40 | A40A |
| 5 Hz - 20 kHz | ±0.02% | ±0.03% |
| 20 kHz - 50 kHz | ±0.03% | ±0.05% |
| 50 kHz - 100 kHz | ±0.05% | |

C41 Storage Case for A40 Shunt

## Ordering Information

### Models

**A40** Current Shunt ***$985***
**A40A** Current Shunt ***$1100***

### Accessories

**A45-4003** Input Cable for A40A Shunt ***$135***
**A45-4004** Output Cable for A40A Shunt ***$175***
**C41** Storage Case for A40 Shunt ***$920***
*Order by current rating, e.g.: A40-10 mA, A40A-10A
Note: National Stock Numbers are available for most A40 and A40A Shunts. Contact your Fluke sales engineer for details.

### Customer Support Services

**Factory Warranty**
One-year product warranty.

# Standards Instruments

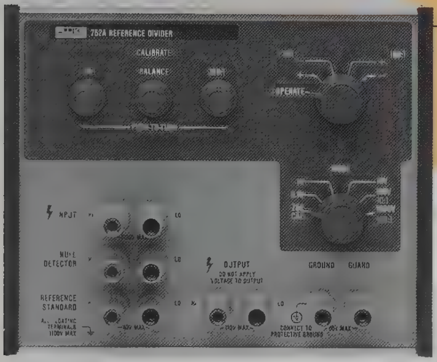
## 752A Reference Divider

10:1 and 100:1 division ratios

Ratio uncertainty of 0.2 ppm on 10:1 ratio

Ratio uncertainty of 0.5 ppm on 100:1 ratio

Built-in calibration bridge



752A

The 752A is a precision 10:1 and 100:1 divider is designed primarily for comparing direct voltage levels of various sources to a 10V standard like a 732B.

Internal switching allows calibration of the 100 mV, 1V, 10V, 100V and 1000V ranges of a voltage calibrator with a 10V standard like the 732B without the need to change connections.

A self-calibration procedure allows you to compensate for long term changes in value of the divider resistors by switching their positions in various Wheatstone bridge configurations.

## Specifications

These specifications apply for the lifetime of the instrument over the temperature range of 18°C to 28°C.

**Ratio Ranges:** 10:1 and 100:1

**Ratio Uncertainty:** The following table specifies the ratio accuracies of the 752A that apply for a temperature variation of less than ±1°C from the self-calibration temperature (between 18°C and 28°C) for up to 8 hours following self-calibration.

| Range | Input Voltage | Output Uncertainty | Null Accuracy* |
|---|---|---|---|
| 10:0 | 0 to 100V | 0.2 ppm | ±0.5 µV |
| 100:1 | 0 to 1000V | 0.5 ppm | ±1.0 µV |

*Null accuracy refers to the required accuracy of the null detector reading during self-calibration

**Temperature Coefficient:** ≤ ±1 ppm per °C over range of 18°C to 28°C (typically 0.1 ppm per °C from 15°C to 30°C)

**Input Resistance**

**10:1 Ratio:** 380 kΩ ±1%

**100:1 Ratio:** Divider is 4 MΩ; Driven Guard is 4 MΩ; total is 2 MΩ ±1%

**Maximum Input Voltage:** 200V for the 10:1 ratio; 1100V for the 100:1 ratio

**Power Coefficient:** ≤ 0.05 ppm of output with 100V applied for 10:1 ratio and ≤ 0.3 ppm of output with 1000V applied for 100:1 ratio (included in the ratio accuracy specifications)

**Temperature:** 0°C to 50°C, operating; −40°C to 75°C non-operating

**Relative Humidity:** ≤ 75% to 40°C, ≤ 45% to 50°C, non-condensing, operating; <100% 10-50°C, non-operating

**Altitude:** ≤ 3050m (10,000 ft) operating; ≤ 12,200m (40,000 ft) non-operating

**Vibration:** Per MIL-T-28800C, Type III, Class 5, Style E

**Safety:** IEC 348, 2nd edition, 1978; ANSI-C39.5, 1980, CSA 556B, and UL 1244

**Size:** 19.1 cm H × 22.1 cm W × 60.3 cm L (7.53 in H × 8.69 in W × 23.75 in L)

**Weight:** 8.4 kg (18.5 lb)

## Ordering Information

### Model

**752A** Reference Divider ***$7875***

### Included with Instrument

Instruction manual.

### Accessories

**5440A-7002** Low Thermal Copper EMF Plug-In Cables ***$475***

**845AB** Voltmeter/Null Detector w/battery pack ***$5445***

**845AR** Voltmeter/Null Detector w/rack mount ***$4895***

### Customer Support Services

### Factory Warranty

One-year product warranty.

# 720A Kelvin-Varley Divider

0.1 ppm resolution, seven decades

0.1 ppm of input absolute linearity

Built-in self calibration bridge

Front panel self-calibration

FUNCTION
BRIDGE BALANCE
INPUT
BRIDGE DETECTOR
BRIDGE POWER
OUTPUT

720A

Model 720A Kelvin-Varley Divider is a high-resolution primary ratio standard with absolute linearity of 0.1 ppm, temperature coefficient of linearity of 0.1 ppm/°C, and self-calibration capability.

## Specifications

**Ratio Range:** 0 to 1.0 (1.0 input tap) and 0 to 1.1 (1.1 input tap)
**Resolution:** 0.1 ppm of input with seven decades
**Absolute Linearity:** (At calibration temperature and without the use of a correct chart) ±0.1 ppm of input at dial settings of 1.1 to 0.1, ±0.1 $(10S)^{1/3}$ of input at dial settings (S) of 0.1 to 0
**Absolute Linearity Stability:** (Without self-calibration) ±1.0 ppm of input/yr at dial settings of 1.1 to 0.1, ±1.0 $(10S)^{2/3}$ ppm of input/yr at dial setting (S) of 0.1 to 0

NOTE: Absolute linearity is defined as the linearity between max and min output voltages. The self-calibration procedure may be used at any time to reset absolute linearity to ±0.1 ppm of input.

**Temperature Coefficient of Linearity:** ±0.1 ppm of input/°C maximum at dial settings of 1.1 to 0.1
**Short-Term Linearity Stability:** Under typical conditions in a standards laboratory environment (temperature maintained within ±1°C) and with an applied voltage of up to 100V, stability of linearity is 0.1 ppm/30 days
**Power Coefficient of Linearity:** ±0.2 ppm of input/W max at dial settings of 1.1 to 0.1; ±0.2 $(10S)^2$ ppm of input/W max at dial settings (S) of 0.1 to 0
**Maximum End Errors:** Zero error at output low: 0.004 ppm of input. Zero error at input low: 0.05 ppm of input. Full-scale error: 0.05 ppm of input
**Maximum Input Voltage:** 1000V on 1.0 input terminal, 1100V on 1.1 input terminal
**Thermal Voltages:** ±0.5 μV max
**Input Resistance:** 100 kΩ ±0.005% at 1.0 input terminal at 25°C; 110 kΩ ±0.005% at 1.1 input terminal at 25°C
**Temperature Coefficient of Input Resistance:** ±1 ppm per °C max
**Size:** 14 cm H × 48.2 cm W × 33 cm D, rack mounted (5.5 in H × 19 in W × 13 in D)
**Weight:** 8.16 kg (18 lb)

## Ordering Information

### Model

**720A** Kelvin-Varley Voltage Divider *$11,240*

### Included with Instrument

Instruction manual.

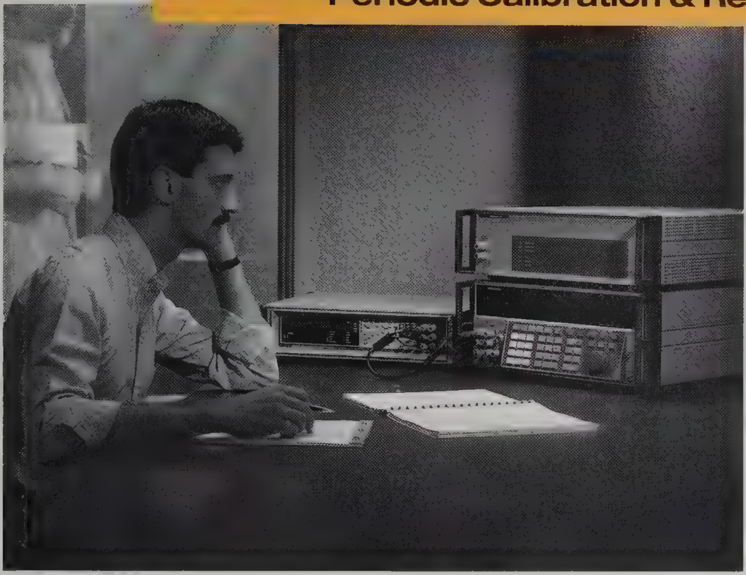
### Customer Support Services

### Factory Warranty

One-year product warranty.

# Calibration Services

## Periodic Calibration & Repair and Service



Fluke provides the expertise and facilities to maintain your calibration products at peak performance.

A wide variety of services are available through our certified service centers located strategically around the world.

For more information, see Section 14.

## Measurement Assurance

### Metrology Services

- State-of-the-art, NVLAP-accredited primary standards laboratory
- Traceability to NIST and Fluke's 10V Array
- Cost-effective convenience

Fluke brings you the convenience of true service with the highest accuracy standards. Our goal is to help you make your calibration lab the best it can be.

### Traceability Maintenance Programs

These innovative, on-site calibration services are offered to Fluke customers as a convenient means for maintaining traceability for your most accurate electronic measuring equipment.

### Direct Voltage Maintenance Program

The Direct Voltage Maintenance Program has been in operation since 1984. This popular on-site service provides you with near-NIST accuracy for the 10-volt output of your dc reference standard without the inconveniences, cost and loss of use of sending your standard to a national standards laboratory.

### 5700A Artifact Calibration Package

Designed for the smaller facility which does not want the expense of owning and maintaining the 10-volt standard and resistors needed for periodic Artifact Calibration of the 5700A. We will send you a characterized 732A or 732B, 742A-1, and 742A-10k, plus the connecting cables and instructions you will need.

### Standards Calibration Services

Send in your standards, we measure them and report their value. If your standard requires repair, arrangements are made with you to most effectively bring your standard back into specification. For information on any of these programs, contact your local Fluke representative.

### Fractional ppm Traceability Using Your 734A

If you are setting up a multiple-reference primary voltage standard, the Fluke 734A provides a proven and flexible low-risk approach that builds on the experience of many other users.

It is good metrology practice to base your primary voltage standard on multiple independent references that you periodically intercompare. With only one standard you have no way to know if it has developed a drift problem. With a second one, you can compare their values periodically, but will not know which one is at fault if they disagree. Three standards can "vote" to determine which one is at fault when you get an unexpected value. Many laboratories maintain their standard in three instruments which never leave the laboratory. A fourth instrument can then be used as a working standard, as a backup in the event one of the primary instruments fails, or to transfer accuracy from their supporting facility.

As you can see in Figure 1, there are also some practical reasons why it is a good idea to have your primary references in physically separate enclosures. Your lab loses the use of an instrument when you send it out for calibration, often for a month or more. If you send only one of them, the others remain available. More importantly, they serve as a check on the one you sent out when it returns. And if one standard fails, it can be sent out for repair without interfering with the use of the others.

It is especially important to use a single reference for your working standard when you send it out of the lab for on-site support of other calibration instruments. You may need to prove to an auditor which reference was used. Moreover, some of your primary voltage standards should always be kept in the lab so they can serve as a check for shifts caused by handling or environmental stress. For the application note, ask for the Fluke Technical Information Note (B0196) "Fractional ppm traceability".

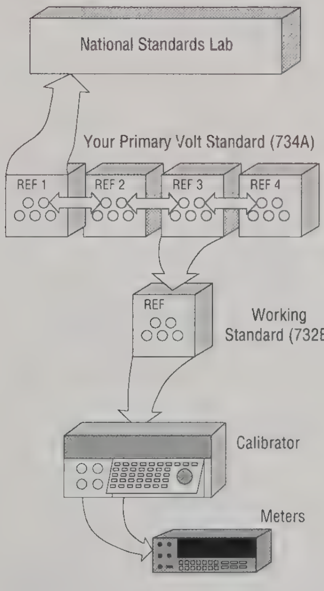


Figure 1. True independence is very practical, as well as good metrology.

# Calibration Services

## Periodic Calibration & Repair and Service

### Additional Information

Numerous technical papers have been published about the Fluke 732A, here are a few:

- *A Primary Standard of Voltage Maintained in Solid-State References,* by Les Huntley.
- *Achieving an Ultra Stable Reference for Modern Standards and Calibration Instrumentation,* by Steve Haynes.
- *10 Volt MAP Using Electronic Reference Standards,* by Dave Agy and Les Huntley.
- *The Fluke Direct Volt Maintenance Program,* by Les Huntley.
- *A Preliminary Evaluation of the Accuracy of 10 Volts as Maintained on the West Coast of the United States,* by Les Huntley and Dave Agy.
- *On an Application For a Solid-State Reference Standard,* by Les Huntley, Ray Kletke, Clem Penco, and Dave Agy.

## Direct Voltage Maintenance Program

Volt traceability for your calibration laboratory with significant cost reductions over direct NIST calibration

Uncertainty within a few tenths of a ppm

Complies with MIL-STD-45662A

Avoid investing in redundant hardware: equipment never needs to leave laboratory

No possibility of accidental loading and destruction as with saturated standard cells

Built around the 732A/B Direct Voltage Reference Standard, the Fluke Direct Voltage Maintenance Program (DVMP) provides state-of-the-art uncertainty for your own laboratory, traceable to the Fluke Josephson Array and the U.S. National Institute of Standards and Technology (NIST). The 732A/B is a solid-state direct voltage reference standard that enables voltage transfers with uncertainties of only a few tenths of a ppm, while meeting the requirements for ruggedness and a range of operating temperatures. This level of performance is made possible by the low, predictable drift rate, allowing accurate extrapolation of the output voltage to be made over long time intervals. With the DVMP, traceability to the Fluke Josephson Array Voltage Standard can be achieved at the 0.1 ppm level. The DVMP also provides traceability to the U.S. legal volt with an uncertainty of 0.4 ppm.

### Traceability

Traceability of your 10V standard is the principle objective of the DVMP. The Fluke Primary Standards Laboratory in Everett, Washington (U.S.A.) operates a 10V Josephson Array Voltage Standard and maintains traceability to NIST at the 10 volt level.

### Four Services to Choose From

The Fluke Direct Voltage Maintenance Program consists of four calibration services, which can be used separately or in combination, depending on your needs. Two of the services are calibrations, performed completely by Fluke personnel. These calibrations are ordered as an option on new 732Bs. The other two calibration services are performed by the user, using Fluke-owned standards, at the user's site, with the data transmitted to the Fluke Standards Lab for reduction and analysis. Complete description of the options follows:

1. **Option 732B-000.** Order this option to have an output voltage calibration performed on a newly ordered 732B. Before shipment, your new 732B will be compared to the direct voltage standards maintained by the Fluke Primary Standards Laboratory. A report of calibration, listing the deviation from nominal and the uncertainty of calibration is delivered with the instrument. The instrument will be delivered under power from self-contained and auxiliary batteries to insure the calibration. Customers outside the U.S. and Canada should order 732B-000I which provides for shipment of the 732B under power up to six days.

2. **Option 732B-100.** Order this option to have a new instrument calibrated for output voltage and characterized for drift rate before shipment from the factory. Your new 732B will be tested for both output voltage and drift rate by comparison against traceable standards for a period of 60 days. Knowing the drift rate, the total uncertainty as a function of time is much reduced. A report of calibration, listing output voltage, drift rate, and uncertainties is delivered with the instrument which is shipped under power. Customers outside the U.S. and Canada should order 732B-100I which provides for shipment of the 732B under power up to six days.

3. **Option 732A-200.** This is the option to order for calibration of your 732A or 732B in your own laboratory. Fluke-owned and calibrated standards, together with all necessary connecting cables and clear operating instructions, will be sent to your site for comparison with your reference standard. A series of readings you make over a period of five days is recorded and returned to Fluke for evaluation at the Fluke Primary Standards Laboratory. A value is then assigned to your 10 volt standard, and a report of calibration is returned to you. After three calibrations without adjustment or repair of your 732A/B, information that allows you to predict output voltages up to one year after calibration with reduced uncertainty is reported. The quoted price for the 732A-200 option includes the shipping costs for the Fluke-owned standards. This service is guaranteed. In the event the transfer standards lose power, the calibration will be repeated at no cost to you.

4. **Option 732B-201.** If you have more than one 732A or 732B in your lab, order this option for calibration of each additional reference at the same site (must be ordered with Option 732B-200). Data collected and reports are the same as described for the 732B-200. For calibration of a 734A, order one 732A-200 and three 732A-201s.

## Specifications

| Option Number | Calibration Uncertainty (CU)* | Drift Rate Uncertainty (DU)** | | | Total Uncertainty |
|---|---|---|---|---|---|
| | | 30 Days | 90 Days | 1 Year | |
| 732B-000 | 0.6 ppm | 0.5 ppm | 1.0 ppm | 3.0 ppm | |
| 732B-100 | 0.5 ppm | 0.35 ppm | 0.5 ppm | 1.0 ppm | $[(CU)^2 + (DU)^2]$ |
| 732A-200 | 0.1 ppm*** | ** | ** | ** | |

* Typical 99% confidence level; actual uncertainties determined at the time of test

** Drift rate uncertainty will be established with repeated participation in the DVMP

*** <0.4 ppm traceable to NIST

# Calibration Services

## Periodic Calibration & Repair and Service

### How To Order

It is important to recognize that proper timing and coordination of the activities between Fluke and your firm are essential to successful delivery of a 732B under power. Following receipt of an order for one of the DVMP services, you will be contacted directly by Fluke factory personnel. For this reason the following information must be included with each order:

- The option number ordered.
- The exact address where the shipment will be received.
- The name and telephone number of the person who will be responsible for receiving the shipment and connecting it to the power line when it arrives.
- The name and telephone number of an alternate responsible person if the first designated individual is unavailable.
- Any restrictions on hours of the day during which receiving can take place.
- Fluke guarantees arrival of the instrument under power. If it is delayed, Fluke or the carrier will pay the shipping charges for return of the instrument to Fluke for recalibration.

## Ordering Information

### Models

**732B-000** 10V Output Voltage Calibration for one 732B, shipped ***Contact Factory***

**732B-000I** 10V Output Voltage Calibration for one 732B for international shipment ***$435***

**732B-100** 10V Output Voltage Calibration and Drift Characterization for one 732B, shipped hot* ***$985***

**732B-100I** 10V Output Voltage Calibration and Drift Rate Characterization for one 732B for international shipment ***Contact Factory***

**732A-200** On-Site 10V Output Voltage Calibration w/Fluke owned standard ***$922***

**732A-201** Calibration of additional standards at 10V on-site ***$407***

*Under power

## Training

### Principles of Metrology

- Five-day in-depth workshop
- Extensive hands-on time on wide range of instruments
- Covers all aspects of dc/low frequency calibration

Principles of Metrology is a five-day workshop covering the essential knowledge required for a technician to be productive in calibrating dc and low frequency ac test instrumentation.

The workshop was designed for personnel whose day-to-day work involves measurements and calibration including engineers or technicians new to the field or individuals involved in the start up of a calibration or metrology laboratory.

**The Workshop Covers:**

Loading errors and how to predict and avoid them
Lead impedance and when to be concerned
Using voltage dividers
Low level measurements
Thermal EMFs and how to avoid them
Grounding and guarding
Standard cells, their maintenance and intercomparisons
Electronic reference standards
Evaluating and calculating measurement system uncertainty

**Literature Available**

Fluke Customer Training Course Planner (00022H)
Principles of Metrology Data Sheet (E0244F)

### Calibration Lab Management

- Extensive five-day workshop
- Learn the basics of establishing and operating a calibration laboratory
- Covers planning, analysis, quality manuals and more

Calibration Laboratory Management is a five-day workshop covering the requirements for establishing and operating a calibration lab. It also provides the tools you will need to organize, develop and manage the operation as an entrepreneurial business.

**Topics Include:**

Quality Manuals
ISO 9000, MIL STD 45662A and other regulations
Market analysis — customer requirements, pricing, competition
Laboratory considerations — layout, equipment, environmental controls
The business plan

**Implementation**

- Day-to-day management

Calibration Laboratory Management is designed for managers, metrologists and technicians involved in setting up a new calibration lab, or those presently involved in cal management who desire new ideas or a new perspective in solving problems or taking advantage of opportunities.

**Literature Available**

Fluke Customer Training Course Planner (00022H)
Calibration Lab Management Data Sheet (E0249D)

### Getting Started in Electrical Calibration

This one day seminar will help those attending to gain valuable insights into the market forces that impact the need for calibration in the 1990s.

The seminar was designed for calibration lab managers, quality engineers, managers or supervisors who may be new to calibration, have been impacted by corporate quality initiatives or ISO 9000, or recognize the need for traceable calibrations but are having difficulty getting started. A copy of the textbook *Calibration: Philosophy & Practice, 2nd Edition* is included.

**Topics Include:**

- Why calibrate
- The chain of traceability
- Calibration philosophy and practice
- Documented procedures and results
- Evaluating products

### MET/CAL Calibration Software Procedure Writing

- Extensive hands-on exercises with instruments
- Five-day extensive workshop
- Access the power of MET/CAL

In this five-day course you will configure MET/CAL software to establish and maintain traceability, create and edit calibration procedures, customize the format of your reports of calibration and calibration certificates and more. More than 30 hours of class time is dedicated to hands-on exercises using Fluke-supplied equipment.

Students also learn how to install, configure and use MET/CAL and to write a range of procedures including open- and closed-loop tests.

**Topics Include:**

- PC fundamentals
- Initial configuration
- Daily operation
- Procedure fundamentals and writing
- Formatting output

MET/CAL Calibration Software Procedure Writing is designed for those with limited experience with automated calibration or MET/CAL and works best for those directly involved in working with or administering a MET/CAL system.

**Literature Available**

Fluke Customer Training Course Planner (00022H)
MET/CAL Procedure Writing Training Data Sheet (E0250B)

### MET/TRACK Workshop

- Extensive hands-on exercises with supplied computers
- Five-day extensive workshop
- Access the information power of MET/TRACK

The MET/TRACK Workshop uses hands-on sessions to learn and understand the structured data collection and powerful searching, sorting and reporting capabilities of this comprehensive metrology information management package.

**Topics Include:**

- PC fundamentals
- Installation
- Field types and uses
- Planning the MET/TRACK system
- Data import and export
- Customization
- Report writing

The MET/TRACK Workshop is designed for lab managers, supervisors and Q/A personnel responsible for managing measurement instrument information. It is ideal for those who need to comply with ISO 9000, MIL STD 45662A or related quality standards.

**Literature Available**

Fluke Customer Training Course Planner (00022H)
MET/TRACK Workshop Data Sheet (E0256B)

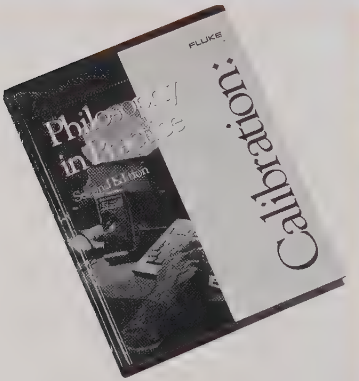
## Calibration: Philosophy in Practice Second Edition

The only comprehensive text book on dc/lf metrology

Hardbound, more than 400 pages

An easy to use source for the new technician or the seasoned metrologist

Includes coverage on the impact of ISO 9000 and other quality standards



The second edition of Calibration: Philosophy and Practice is a complete and thorough update of the only comprehensive textbook on dc/low frequency metrology.

It covers real world concepts and applications and is designed and written for the working technician and contains clear descriptions of all concepts and generous use of photos and diagrams to help illustrate subjects.

Calibration: Philosophy and Practice covers the entire subject of dc/lf metrology. Subjects include:

**Elements of Metrology**

- International system of units (SI)
- Standards and traceability
- Lab operation and environment
- ISO 9000 and other quality standards

**Primary and Secondary Standards**

- AC, DC, voltage and current, resistance, ratio, capacitance, inductance, immitance and time and frequency

**Calibrators and Calibration**

- Meters
- Scopes
- Artifact Calibration
- Automation

**Statistics and Specifications**

- Application of statistics in metrology
- Interpreting instrument specifications
- Statistical Process Control

**Laboratory Management**

- Environment
- Workload management
- Selecting new equipment
- Lab accreditation
- Audits

**Practical Considerations**

- Guarding and grounding
- Parasitics

**Full index, comprehensive glossary, and more.**

Calibration: Philosophy and Practice is both an excellent training guide for new technicians as well as a reference tool for the working technician, engineer or metrologist. No calibration or service lab should be without one.

## Ordering Information

### Training

| | | |
|---|---|---|
| **TRC1000** | Principles of Metrology | ***$1495*** |
| **TRC1001** | Getting Started in Electrical Calibration | ***$1495*** |
| **TRC1005** | Calibration Lab Management | ***$1495*** |
| **TRC1006** | MET/CAL Procedure Writing | ***$1495*** |
| **TRC1007** | MET/TRACK Software Workshop | ***$1495*** |

For additional information on this and other courses as well as scheduling information, contact your local Fluke representative

**Calibration: Philosophy and Practice*** ***$69***

** Quantity discounts are available*

# PM 2800 Family of Programmable Power Supplies

Single, dual and triple output versions

60W or 120W output power options

Autoranging power modules for maximum versatility in terms of voltage and current

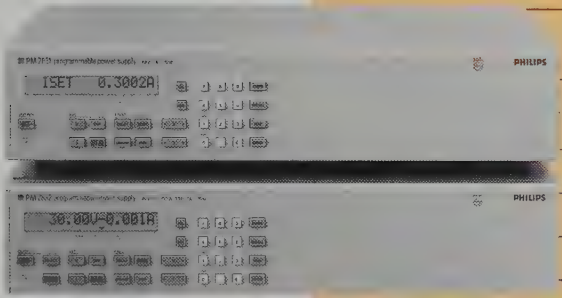
Linear power modules for current source/sink capability (PM 2831 & PM 2832 series)

GPIB/IEEE-488.2 interface with SCPI protocol for easy programming

Internal memory stores 999 voltage & current settings

Built-in metering (readback) for voltage and current

Constant voltage, constant current, overvoltage/overcurrent protection modes



PM 2831 & PM 2832

The Fluke line of Programmable Power Supplies was created with automated testing in mind. The GPIB/IEEE-488* interface, output power module and output metering facilities are built-in, taking up only 2 engineering units of rack height. The full rack-width models come equipped with rack mount ears for easy installation in a standard 19" rack.

The front panel allows full access to all instrument functions, including voltage and current readback.

A sequence of front panel settings can be created with the AUTOSTEP mode, quickly creating an automated test pattern of user-defined voltages and currents with no need for a controller.

The optional front panel output gives the user easy access to both the power output connections and the sense lines; great for prototyping and temporary set-ups.

## Versatile Power

Fluke now offers two types of power modules:

**Autoranging** power modules for superior current and voltage versatility. The PM 2811, PM 2812 and PM 2813 offer autoranging in 60W and 120W modules, up to 180W per mainframe.

**Linear** power modules for current source/sink capability. The new PM 2831 and PM 2832 family offers linear power modules from 120W up to 240W per mainframe.

## Voltage Source or Current Source

The power supply can act either as voltage source or as current source, depending on the load conditions and the selected values of voltage and current.

## Versatile Programming

Every model comes equipped with the GPIB/IEEE-488.2 interface which supports the Standard Commands for Programmable Instruments (SCPI).

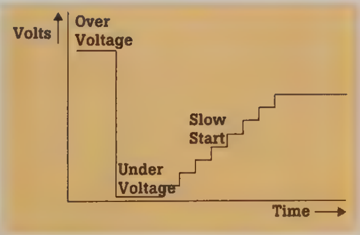
By conforming to this industry standard in programming, the task of creating and supporting application programs is made easier.

The front panel interface is more than just a readback facility. From the front panel the user can access all of the functions that are implemented in GPIB.

## Internal Memory and Autostep

Up to 999 settings of voltage and current can be stored and recalled from the internal non-volatile memory (valid per output). The last instrument settings are automatically stored on power down.

The STEP function allows the voltage and current settings stored in the internal memory to be recalled successively, and to be activated, if the supply is in Operate Mode, by pressing a single key. A repetitive pattern can be created using AUTOSTEP to sequence front panel settings at a user-defined rate.



The figure shows a voltage pattern for supplying over and undervoltage and slow start-up to a device under test, using AUTOSTEP.

The power supplies are equipped with external trigger lines which can be used to recall voltage and current settings from the internal memory. This allows accurate synchronization with other equipment and results in less GPIB traffic.

## Extensive Protection Features

To protect your device under test, an extensive set of protection features has been included. Over Voltage and Over Current limit values can be set by the user. When a limit value is reached, power is removed from the outputs within only a few milliseconds.

Voltage and Current are constantly monitored by a separate readback circuit with its own sense lines for measuring voltages directly at the load. A programmable delay feature allows protection to ignore short term overloads, such as current surges during a turn-on sequence. The Coupled Protection feature ensures that an overload in one output will shut down all other outputs, simultaneously, an important feature for applications requiring positive and negative balanced voltages such as operational amplifiers. The power supplies continuously monitor themselves for internal over-temperature conditions. Output power can be turned on and off using the Operate/Standby mode which can be selected with a front panel key or is programmable via the GPIB interface.

## Easy Calibration

Closed case calibration means the power supply does not have to be removed from the rack for calibration. A calibrated multimeter and a load are all that is required. Access to the calibration mode is protected with a user-defined password.

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*The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

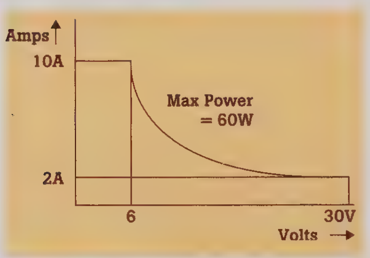
# PM 2800 Family of Programmable Power Supplies

### Reliability You Expect

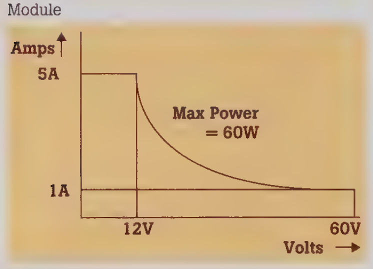
Reliability of power supplies is of extreme importance. The Fluke programmable power supplies, with extensive internal self-monitoring, device protection features and a generous amount of cooling, are designed for years of trouble-free service.

### PM 2811/12/13 Autoranging Series Programmable Power Supplies

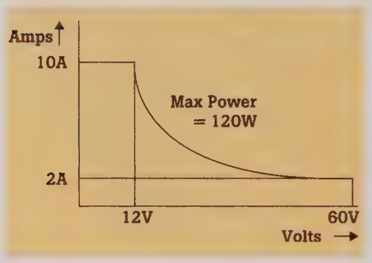
- Single, dual and triple output versions.
- 60W, 120W Power output options.
- Autoranging for maximum versatility with voltage & current



Autoranging Curve for 30V/10A/60W Power Module



Autoranging Curve for 60V/5A/60W Power Module



Autoranging Curve for 60V/10A/120V Power Module

## Specifications

### Technical Specifications

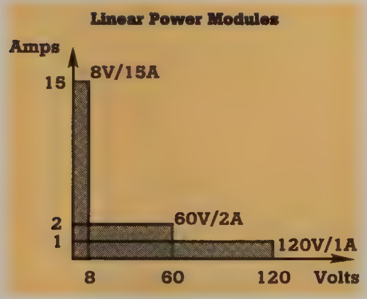
| | | | |
|---|---|---|---|
| **OUTPUT** | | | |
| Power | 60W | 60W | 120W |
| Voltage | 30V | 60V | 60V |
| Current | 10A | 5A | 10A |
| **Accuracy** | | | |
| Voltage | 0.04% + 10 mV | 0.04% + 20 mV | 0.04% + 20 mV |
| Current | 0.1% + 50 mA | 0.1% + 25 mA | 0.1% + 50 mA |
| OVP | 0.5% + 150 mV | 0.5% + 250 mV | 0.5% + 250 mV |
| **PARD (DC to 20 MHz)** | | | |
| CV (pp/rms) | 15 mV/3 mV | 30 mV/6 mV | 30 mV/6 mV |
| CC rms | 10 mA | 10 mA | 10 mA |
| **Source Effect (line ±10%)** | | | |
| Voltage | 0.01% + 2 mV | 0.01% + 2 mV | 0.01% + 2 mV |
| Current | 0.02% + 2 mA | 0.02% + 2 mA | 0.02% + 2 mA |
| **Load Effect (load change 10% to 90% or 90% to 10%)** | | | |
| Voltage | 0.01% + 5 mV | 0.01% + 5 mV | 0.01% + 5 mV |
| Current | 0.02% + 5 mA | 0.02% + 5 mA | 0.02% + 5 mA |
| **Long Term Drift** | | | |
| Voltage | 0.04% + 5 mV | 0.04% + 5 mV | 0.04% + 5 mV |
| Current | 0.05% + 10 mA | 0.05% + 10 mA | 0.05% + 10 mA |
| **Programming Resolution (12 bit)** | | | |
| Voltage | 7.5 mV | 15 mV | 15 mV |
| Current | 2.5 mA | 1.25 mA | 2.5 mA |
| OVP | 7.5 mV | 15 mV | 15 mV |
| **READBACK** | | | |
| **Resolution** | | | |
| V and I | 12 bit | 12 bit | 12 bit |
| **Accuracy** | | | |
| Voltage | 0.05% + 25 mV | 0.05% + 50 mV | 0.06% + 50 mV |
| Current | 0.1 % + 30 mA | 0.1 % + 15 mA | 0.2 % + 30 mA |
| **DYNAMIC OPERATION** | | | |
| **Load Transients** | **ΔI = 1A*** | **ΔI = 0.5A**** | **ΔI = 0.5A***** |
| Settling Band | 50 mV | 50 mV | 50 mV |
| Overshoot | 150 mV | 150 mV | 150 mV |
| Recovery Time | 1 ms | 2 ms | 2 ms |
| **Programming Response Time** | | | |
| $T_{rise}$ | 100 ms | 200 ms | 200 ms |
| $T_{rise}$ (no load) | 50 ms | 100 ms | 100 ms |
| $T_{fall}$; (V max to 1V) | 100 ms | 200 ms | 200 ms |
| $T_{fall}$ (no load); (V max to 1V) | 250 ms | 500 ms | 500 ms |
| **SENSE CAPABILITY** | | | |
| Minimum Voltage per Lead | 0.25V | 0.25V | 0.25V |

All regulations are + or the values listed * (1A to 10A) ** (0.5A to 5A) *** (1A to 10A)

### PM 2831/32 Linear Series Programmable Power Supplies

- Single and dual output models.
- Low ripple and noise.
- Fast up and down programming.
- Current source/sink capability.

The PM 2830 series can sink as well as source current. Because the current sink level is programmable, the power supply can act as an electronic load.



## Technical Specifications (cont.)

| | | | |
|---|---|---|---|
| **OUTPUT** | | | |
| Power | 120W | 120W | 120W |
| Voltage | 8V | 60V | 120V |
| Current at 40°C | ±15A | ±2A | ±1A |
| at 45°C | +12.5A/−15A | ±2A | ±1A |
| at 50°C | +10A/−15A | ±2A | ±1A |
| **Accuracy** | | | |
| Voltage | 0.04% + 4 mV | 0.04% + 15 mV | 0.04% + 30 mV |
| Current (+ and −) | 0.24% + 8 mA | 0.04% + 0.5 mA | 0.04% + 0.25 mA |
| OVP | 0.04% + 4 mV | 0.04% + 15 mV | 0.04% + 30 mV |
| **PARD (DC to 20 MHz)** | | | |
| CV (pp/rms) | 4 mV/1 mV | 6 mV/1 mV | 6 mV/1 mV |
| CC rms | 15 mA | 2 mA | 2 mA |
| **Source Effect (line ±10%)** | | | |
| Voltage | 1 mV | 2 mV | 2 mV |
| Current | 4 mA | 1 mA | 0.5 mA |
| **Load Effect (load change 10% to 90% or 90% to 10%)** | | | |
| Voltage | 1 mV | 2 mV | 2 mV |
| Current | 4 mA | 1 mA | 0.5 mA |
| **Long Term Drift** | | | |
| Voltage | 0.02% | 0.02% | 0.02% |
| Current | 0.02% | 0.02% | 0.02% |
| **Programming Resolution (12 bit)** | | | |
| Voltage | 2 mV | 15 mV | 30 mV |
| Current | 3.75 mA | 0.5 mA | 0.25 mA |
| OVP | 2.5 mV | 15.5 mV | 30.5 mV |
| **READBACK** | | | |
| **Resolution** | | | |
| V and I | 12 bit | 12 bit | 12 bit |
| **Accuracy** | | | |
| Voltage | 0.05% + 4 mV | 0.05% + 15 mV | 0.05% + 30 mV |
| Current (+ and −) | 0.05% + 8 mA | 0.05% + 1 mA | 0.05% + 0.5 mA |
| **DYNAMIC OPERATION** | | | |
| **Load Transients** | ΔI = 7.5A | ΔI = 1A | ΔI = 0.5A |
| Settling Band | 4 mV | 30 mV | 60 mV |
| Overshoot | 100 mV | 100 mV | 100 mV |
| Recovery Time | 100 µs | 100 µs | 100 µs |
| **Programming Response Time** | | | |
| $T_{rise}/T_{fall}$ no load | 500 µs | 500 µs | 500 µs |
| $T_{rise}/T_{fall}$ | 1 ms @ 7.5A | 1 ms @ 1A | 1 ms @ 0.5A |
| Overshoot (max.) | 300 mV | 300 mV | 300 mV |
| **Source/Sink** | | | |
| Switching Time | 1 ms | 1 ms | 1 ms |
| Source/Sink Level | 0.6V | 0.6V | 0.6V |
| Hysteresis | 150 mV | 150 mV | 150 mV |
| **SENSE CAPABILITY** | | | |
| Minimum Voltage per Lead | <4V: 2V<br>>4V: $(8-V_{set})/2$V | 1V | 1V |

All regulations are + or – the values listed

# PM 2800 Family of Programmable Power Supplies

## General Specifications

### Safety

IEC-348, class 1: PM 2811, PM 2812, PM 2813
IEC 1010-1: PM 2831, PM 2832
For all models: VDE 0411, CSA-C22.2 No. 231, UL 1244

### EMC

**Emission:** VDE 0871; CISPR 11
**Susceptibility:** IEC 801

### Environmental Data

MIL-T-28800D, Type III, Class 5, Style E
**Operating Temp.:** 0°C to 50°C
**Storage Temp.:** –20°C to +70°C

### Supplemental Characteristics

**Isolation:** 240V above ground

### Mechanical Data

**Height:** (excl. feet): 87 mm (3.43 in)
**Feet:** 18 mm (0.71 in)
**Width:** For PM 2811 210 mm (8.27 in); For PM 2812, PM 2813, PM 2831 and PM 2832 420 mm (16.54 in)
**Depth:** 381 mm (15.0 in)
**Weight:** For PM 2811: 5.5 kg (12 lb); For PM 2812 and PM 2813: 9.5 kg (21 lb) For PM 2831 10 kg (22 lb) and PM 2832 14 kg (31 lb)

### Power Requirements

**Line Voltage:** 115V ac ±10%; 230V ac ±10%
**Line Frequency:** 50 or 60 Hz
**Power Consumption:** PM 2811: 1.4A/110V, 0.8A/220V
PM 2812: 2.6A/110V, 1.4A/220V
PM 2813: 3.7A/110V, 2.0A/220V
PM 2831: 2.4A/115V, 1.2A/230V
PM 2832: 4.8A/115V, 2.4A/230V
at maximum load

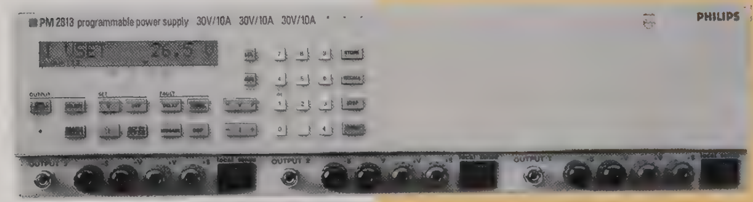
Operator's manual and line cord included with instrument. PM 2812, PM 2813, PM 2831 include rackmount ears.

### Front Panel Output Connectors

These are available for any power supply in the PM 2800 family and must be ordered factory installed only.

The part number of each power supply ordered with front panel outputs is as follows:
PM 28xx/x5x

**Example**
PM 2811/053 Single Output, 30V/10A/60W with front panel connectors, US version.



## Ordering Information

| Outputs & Models | Front Panel Output | Rear Panel Output | 30V 10A 60W | 60V 5A 60W | 60V 10A 120W | Price Eff. 7/1/95 |
|---|---|---|---|---|---|---|
| **Autoranging Single** | | | | | | |
| PM 2811/01N* | | X | 1 | | | *$1895* |
| PM 2811/053 | X | | 1 | | | *$1995* |
| PM 2811/113 | | X | | 1 | | *$1895* |
| PM 2811/153 | X | | | 1 | | *$1995* |
| **Dual** | | | | | | |
| PM 2812/013 | | X | 2 | | | *$3345* |
| PM 2812/053 | X | | 2 | | | *$3485* |
| PM 2812/113 | | X | | 2 | | *$3345* |
| PM 2812/153 | X | | | 2 | | *$3485* |
| PM 2812/213 | | X | 1 | 1 | | *$3345* |
| PM 2812/253 | X | | 1 | 1 | | *$3485* |
| PM 2812/313 | | X | 1 | | 1 | *$3780* |
| PM 2812/353 | X | | 1 | | 1 | *$3955* |
| PM 2812/413 | | X | | 1 | 1 | *$3780* |
| PM 2812/453 | X | | | 1 | 1 | *$3955* |
| **Triple** | | | | | | |
| PM 2813/013 | | X | 3 | | | *$3960* |
| PM 2813/053 | X | | 3 | | | *$4210* |
| PM 2813/113 | | X | | 3 | | *$3960* |
| PM 2813/153 | X | | | 3 | | *$4210* |
| PM 2813/213 | | X | 2 | 1 | | *$3960* |
| PM 2813/253 | X | | 2 | 1 | | *$4210* |
| PM 2813/313 | | X | 1 | 2 | | *$3960* |
| PM 2813/353 | X | | 1 | 2 | | *$4210* |

| Outputs & Models | Front Panel Output | Rear Panel Output | 8V 15A 120W | 60V 2A 120W | 120V 1A 120W | Price Eff. 7/1/95 |
|---|---|---|---|---|---|---|
| **Linears Single** | | | | | | |
| PM 2831/013 | | X | | 1 | | *$2265* |
| PM 2831/053 | X | | | 1 | | *$2360* |
| PM 2831/113 | | X | | | 1 | *$2265* |
| PM 2831/153 | X | | | | 1 | *$2360* |
| PM 2831/213 | | X | 1 | | | *$2265* |
| PM 2831/253 | X | | 1 | | | *$2360* |
| **Dual** | | | | | | |
| PM 2832/013 | | X | | 2 | | *$3890* |
| PM 2832/053 | X | | | 2 | | *$4070* |
| PM 2832/113 | | X | | | 2 | *$3890* |
| PM 2832/153 | X | | | | 2 | *$4070* |
| PM 2832/213 | | X | | 1 | 1 | *$3890* |
| PM 2832/253 | X | | | 1 | 1 | *$4070* |
| PM 2832/313 | | X | 2 | | | *$3890* |
| PM 2832/353 | X | | 2 | | | *$4070* |

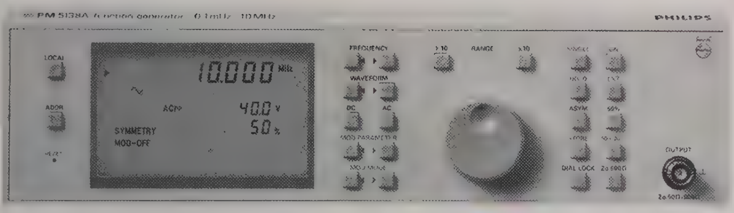
*1 = Outputs rear
5 = Outputs front

The **n** indicates the required line cord. To select your line cord substitute the **n** by:
1 Universal Euro 220V/16A. 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

### Accessories

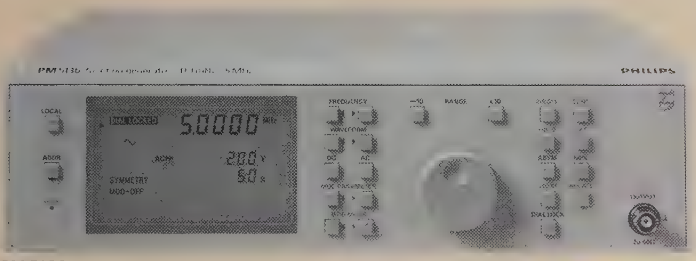
**PM 2392/011** Cable Set for external trigger line *$185*
**PM 9280/041** Rack Mount Kit for PM 2811 *$345*

# Signal Sources



PM 5138A

**New** *Feature*



PM 5136

**New**

PM 5150

From ultra high-frequency L-Band applications to low-frequency mechanical testing, Fluke offers signal sources to fit your budget and performance needs.

The PM 5138A and PM 5139 for example offer the convenience of menu-driven operation, with a wide range of waveforms. The PM 5139 features a 20 MHz range plus an internal modulation source programmable from 1 mHz to 100 kHz for AM, FM, Burst, Gated, and PSK modulation. The PM 5193 offers superb systems performance: 50 MHz range, eight digit resolution, eight waveforms and five modulation modes.

Choose from 20 standard waveforms or create your own custom waveform with the powerful front panel editor or via the IEEE-488.2 interface by using the PM 5150 Arbitrary Waveform Generator. The optional sequence generator links and repeats selected waveforms to allow complex patterns to be generated.

And AnyWave 2.0 Software lets you upload and download, edit store and print waveforms quickly and easily – all from your PC. AnyWave also allows you to acquire, upload and download real life waveforms from Fluke Digital Storage Oscilloscopes.

The 5786 Pulse Generator has the speed and versatility to handle virtually any analog or digital circuit testing requirement. Fast digital circuitry such as TTL or ECL is easily handled, and the wide choice of external trigger and gate functions make the setting up of special test signals easy.

## Contents

**Selection Guide**
Page 164
**Function Generators**
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**Pulse Generators**
Page 182

# Signal Sources

## Signal Source Selection Guide

### Synthesized Function Generators

| Models | Frequency Range Hz-MHz | Setting ± Error | Output Vp-p[1] | DC Offset | Waveforms | | | | | | | | Var. Duty Cycle |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | ∿ | ⊓⊔ | ∧∨ | ⊓ or ⊔ | ⟋ or ⟍ | ∩ | ⋂ | ∧ | |
| PM 5136 | 0.0001-5 | 2 ppm | 20 | ● | ● | ● | ● | ● | ● | | | | ● |
| PM 5138A | 0.0001-10 | 2 ppm | 40 | ● | ● | ● | ● | ● | ● | | | | ● |
| PM 5139 | 0.0001-20 | 2 ppm | 20 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PM 5191[3] | D | 0.0001-2 | 1 ppm | 30 | ● | ● | ● | ● | | ● | | | |
| PM 5193[2 3] | D | 0.0001-50 | 1 ppm | 20 | ● | ● | ● | ● | ● | ● | ● | | |

(1) Into open circuit
(2) 'S' version features 10 MHz external sync.
(3) Also available: PM 5193V with video modulation

### Arbitrary Waveform Generators

| Models | Memory Seg Parts | Vertical Res | Sample Freq S/s-MS/s | Setting ±Error | Output Vp-p[1] | DC Offset | Waveforms | | | | | | | | Var. Duty Cycle |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | | | | | ∿ | ∧∨ | ⊓⊔ | ⊓ or ⊔ | ⟋ or ⟍ | ∩ | ⋂ | ∧ | |
| PM 5138A | 24k/24 | 10 Bit | 1-20 | 2 ppm | 40 | ● | ● | ● | ● | ● | ● | | | | ● |
| PM 5139 | 24k/24 | 10 Bit | 1-20 | 2 ppm | 20 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |
| PM 5150[2] | 32k/1-100 | 12 Bit | 1-20 | 50 ppm | 20 | ● | ● | ● | ● | ● | ● | ● | | | ● |

(1) Into open circuit
(2) PM 5150 Waveforms not listed: Pos and Neg Exponential, Gaussion, Circle, Sin x/x and noise
(3) Waveforms can be transferred directly from a Fluke CombiScope™ instrument into the arbitrary memory, or use AnyWave
(4) RS-232 and GPIB not available together

### Pulse Generators

| Models | Transition Time | Duration | Operating Modes | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | | Max Frequency | Square Wave | Double Pulse | Counted Burst | External Trigger | Variable Trigger Level |
| PM 5712 | 4 ns | 10 ns to 100 ms | 50 MHz | ● | ● | | ● | |
| PM 5715 | 6 ns to 0.5s | 10 ns to 100 ms | 50 MHz | ● | ● | | ● | |
| PM 5786 | 2 ns to 0.1s | 3.5 ns to 100 ms | 125 MHz | ● | ● | Option | ● | ● |

### RF Generator

| Models | Frequency | | | Amplitude | | | | Modulation | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Minimum kHz | Maximum MHz | Resolution Hz | Minimum dBm | Maximum dBm ● | Resolution dB | Int. Source kHz | AM | FM | FM Stereo | RDS ARI | Video | Sweep |
| PM 5330 | 100 | 180 | 10 | −127 | +13 | 0.1 | .02-20 | ● | ●[1] | Opt[1] | Opt | | ● |

● = At maximum carrier frequency
(1) Pre-emphasis selectable 0-50-75 μs

# Signal Sources

| Models | Output Characteristics | | | Sweep | | Burst | Single Shot | Gate | AM | FM | PSK | Internal Modulation Source | RS-232 | GPIB |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 600Ω | 50Ω | TTL | Lin. | Log. | | | | | | | | | |
| PM 5136 | | • | • | • | • | • | • | | • | • | | 1 kHz | | Option |
| PM 5191(6) | | • | • | | | | | | • | | | 1 kHz | | • |
| PM 5193(5,6) | | • | • | • | • | • | • | • | • | • | | 10 Hz-200 kHz | | • |

(1) Into open circuit
(2) A = Analog D = Digital
(3) Also available: PM 5133S (adds audio sweep according to DIN 45541)
(4) In the PM 5134 crystal mode and crystal AM mode
(5) 'S' version features 10 MHz external sync.
(6) Also available: PM 5193V with video modulation

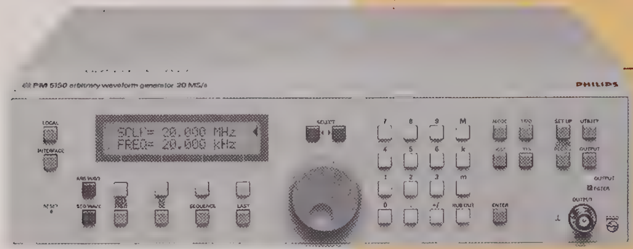
| Models | Output Characteristics | | Sweep | | Burst | Single Shot | Gate | AM | AM SCM | FM | PSK | Internal Modulation Jitter Source | RS-232 (3) | GPIB (3) |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 50Ω | TTL | Lin. | Log. | | | | | | | | | | |
| PM 5138A | •/600Ω | • | • | • | • | • | • | • | | • | • | 1 kHz | Opt(4) | Opt(4) |
| PM 5139 | •/LowZ | • | • | • | • | • | • | • | | • | • | 0.1 mHz-100 kHz | Opt(4) | Opt(4) |
| PM 5150(2) | • | • | • | • | • | • | • | • | • | • | | 0.02-10 sec | • | • |

| Models | External Control | | | Outputs | | | | |
|---|---|---|---|---|---|---|---|---|
| | Variable Delay | External Duration | External Gate | Amplitude (50Ω Load) | Offset (50Ω Load) | Pulse Outputs | Sync (Clock) | GPIB |
| PM 5712 | 10 ns to 100 ms | • | • | 0.2V to 10V | −5V to +2V | A | •(2) | |
| PM 5715 | 10 ns to 100 ms | • | • | 0.2V to 10V | −5V to +2.5V | A | •(2) | |
| PM 5786 | 8 ns to 100 ms | • | • | 0.2V to 5V | −2.5V to +2.5V | A,B | • | |

| Models | Purity | | | SSB Ø Noise | | Res FM | | Miscellaneous | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Mod Out | Har-monics dBc • | Spurious dBc • | For 1 Hz BW dBc | At Freq MHz | With Offset kHz | BW at 500 MHz Hz | RMS, 3 kHz Rev Pwr Protect | Freq and Amp Stepping | NVM Places | RS-232 | GPIB |
| PM 5330 | • | −40 | −55 | −105 | 480 | 20 | 10* | • | • | 75 | Opt | Opt |

• = Standard in instrument
opt = Optional available: opt 1 = PM 9546 = Universal PAL/NTSC chroma module
opt 2 = PM 9553G = Y/C + RGB module

## PM 5150 20 MS/s Arbitrary Waveform Generator



PM 5150

- Versatile waveform creation and editing facilities
- 20 standard waveforms
- Deep 32K waveform memory allows generation of up to 100 waveforms
- 0.1 Sample/s to 20M Samples/s sample clock
- Digital waveform synthesis with 12-bit amplitude resolution
- Optional sequence generator links or repeats waveforms to run extended tests
- Waveform addition, subtraction and multiplication facility
- RS-232C and GPIB/IEEE-488.2 interfaces standard

The PM 5150 offers an exceptional combination of versatility and value in arbitrary waveform generation: a total of 20 standard waveforms, plus the ability to generate any desired custom waveshapes for special test and signal-simulation purposes.

### 32K of Waveform Memory

With 32K of non-volatile waveform memory (32,768 points), of which 31K is freely assignable, the most complex waveshapes and patterns can be created and stored for instant recall at any time. This gives the user a powerful capability to generate specific waveshapes for a virtually unlimited variety of tests and simulations, using input signals closely matching those encountered under actual operating conditions.

The generator's memory is divided into individually addressable segments, each of which can contain a separate waveform. Up to 100 segments can be defined by the user. Each segment is assigned a waveform number by means of which the waveform stored in it can be conveniently recalled whenever it is needed.

### Precision Waveform Generation

All waveforms are digitally synthesized, with 12-bit amplitude resolution (4095 points) for high accuracy. The digital synthesis principle ensures high waveform quality, with low sine distortion and excellent triangle and ramp linearity. The accurate internal clock generates sample frequencies of up to 20 MS/s, covering a wide range of output signal frequencies.

### Convenient Waveform Definition

Waveform definition and editing have been made exceptionally simple, thanks to the PM 5150's innovative line segment 'draw' mode and waveform construction using the optional mouse or via the front-panel keypad. This feature allows either complete waveforms to be constructed from scratch, or existing standard or user-defined waveforms to be modified as desired.

The 'Line' mode enables waveforms to be defined by drawing a series of chords from a set of anchor points, using just a few movements of the mouse or rotary control, or keypad strokes.

The alternative 'Vector' mode allows any existing waveforms to be modified. All that is necessary is to define the active waveform edit area by means of anchor points at its left and right extremities, and choose one of the three available waveform modification modes. The 'Vertex' mode allows a new waveform section to be created simply by defining a new vertex point anywhere in the active edit area; the 'Insert' mode allows direct 'cut-and-paste' replacement of the old waveform section with a new section defined by the user; and the 'Sum' mode allows a new waveform section to be summed with the existing section.

### Waveform Math Operations

Additional tools for defining custom waveforms are the mathematical operations addition, subtraction and multiplication, which allow new, composite waveforms with precisely defined characteristics to be created with just a few simply controlled operations.

These operations open-up numerous possibilities to generate special test signals; for example by adding transients, by adding or subtracting signals to create tone bursts; or by multiplying two waveforms to create amplitude-modulated signals. Furthermore all these operations can be iterated multiple times, adding extra versatility.

### Waveform Scaling

Another method of modifying existing waveforms is by the use of digital scaling, which allows the amplitude and offset of the waveform between the two anchor points to be changed. Digital amplitude control automatically scales – or even inverts – any waveform between the defined anchor points, while digital offset control shifts a waveform in either the positive or negative direction.

### AnyWave PC Software

A waveform captured by a Fluke Digital Storage Oscilloscope can be transferred to a PC and modified using the AnyWave PC software tool for creating, capturing, and modifying waveforms, and transferring them quickly and easily to the PM 5150. You can create your own archival library of custom waveforms on your hard disk.

Alternatively, any desired waveform can be captured from a test system using a Fluke DSO and then transferred to the PM 5150 without the need for a PC.

### Versatile Waveform Sequence Generation

Even more versatility is provided by the optional sequence generator, which allows any of the waveforms stored in memory – either standard or user-defined – to be concatenated without requiring additional memory space. Waveform sequences can also include loops, in which any of the stored waveforms may be repeated a large number of times. In this way, extended and repetitive test sequences far exceeding the standard memory capacity can be generated.

Programmed waveform sequences may contain as many as 1000 steps, and up to 100 programmed sequences can be defined and stored in memory. The available library of up to 100 waveforms,

GPIB
IEEE-488

RS-232

---

*The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

## PM 5150 20 MS/s Arbitrary Waveform Generator

and the ability to define sequences in excess of a million counts per step, add up to a tremendous virtual expansion of the available memory. This facility offers an unprecedented capability to define and run complex arbitrary test patterns from a single, economic and easy-to-operate instrument.

Just a few examples of the sequences that can be generated with this feature include stepped frequency sweeps, in which single waveforms can be inserted between long, repetitive bursts of other waveforms to simulate specific duty cycle conditions; a continuous signal stream with occasional interruptions.

### Choice of 20 Standard Waveforms

The wide choice of 20 standard waveforms gives instant access to numerous frequently required test signals. These can be used as they are, or subjected to any of the PM 5150's math, scaling and editing operations to create modified or completely new signals. In addition the standard waveforms can also be incorporated in programs created using the optional sequence generator. These standard waveforms are: sine, triangle, square, ramp (±), dc, pulse (±), exponential (±), AM, SCM, FM, lin./log. sweep, noise, sin x/x, Gaussian, haversine and circle.

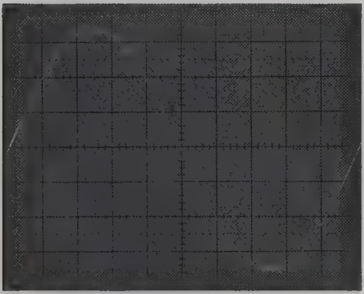


Fig. 1 Just select the two anchor points on the arbitrary waveform, and the part of the waveform between these points can be manipulated.

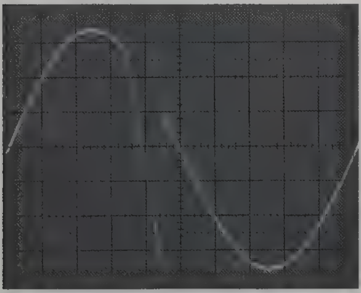


Fig. 2 shows "Vector" mode editing using a cursor.

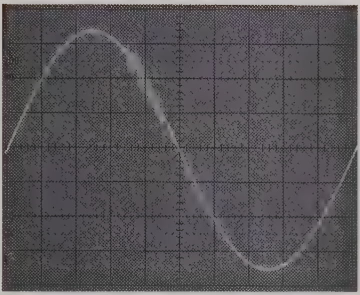


Fig. 3 shows the addition of a noise signal between the anchors to a sine wave.

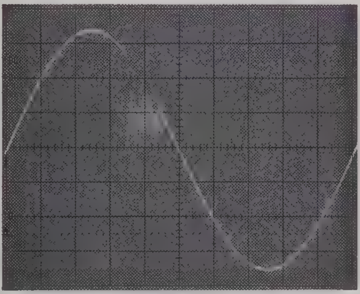


Fig. 4 shows the insertion of a noise signal between the anchors.

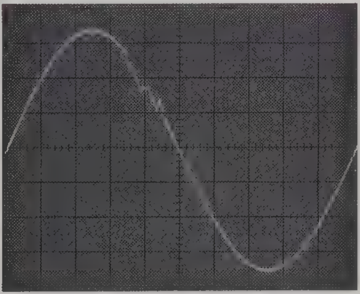


Fig. 5 shows the average function of a noise signal between the anchors.

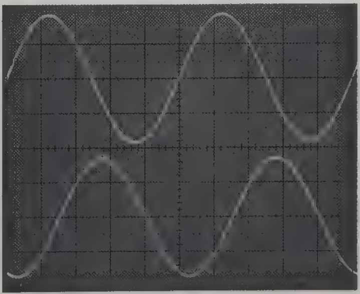


Fig. 6 shows two synchronized PM 5150 arbitary waveform generators, with variable phase setting between the two main outputs of the generators. The phase can be set with very high accuracy over the range from 0 to 360 degrees.

### Multi-Channel Operation

Reference and Sync connectors are provided for connection of multiple units to provide synchronous outputs with any desired phase offset. For example, three generators can be connected together with a 120° phase offset for simulation of a three-phase power network. The phase can be set with a resolution of 0.001°.

### Standard RS-232C and GPIB/ IEEE-488.2 Interfaces

The PM 5150's standard RS-232C interface enables mouse-controlled editing. The GPIB/IEEE-488.2 interface allows the PM 5150 to be integrated into automated GPIB measurement and instrumentation systems, for example in automated testing applications such as in production-line environments. The interface enables full remote programmability of the PM 5150, together with facilities for downloading of user-defined test set-ups and routines. The IEEE-488 interface is also used for downloading of captured waveforms from a DSO.

# PM 5150 20 MS/s Arbitrary Waveform Generator

## Specifications

### Technical Specifications

#### Sampling Frequency

**Total Range:** 100 mHz to 20 MHz (50 ns to 10s per sample)

| Frequency Subrange | Resolution |
|---|---|
| 100.0 to 999.9 mHz | 0.1 mHz |
| 1.000 to 9.999 Hz | 1 mHz |
| 10.00 to 99.99 Hz | 10 mHz |
| 100.0 to 999.9 Hz | 100 mHz |
| 1.000 to 9.999 kHz | 1 Hz |
| 10.00 to 99.99 kHz | 10 Hz |
| 100.0 to 999.9 kHz | 100 Hz |
| 1.000 to 9.999 MHz | 1 kHz |
| 10.000 to 20.000 MHz | 2 kHz |

**Accuracy:** ±50 ppm

#### Amplitude

**AC Voltage p-p Open Circuit**

| Range | Resol. | Error limits |
|---|---|---|
| 2.00V to 20.00V | 10 mV | ±1% of setting ±40 mV |
| 200 mV to 2.000V | 1 mV | ±3% of setting ±10 mV |
| 20.0 mV to 200.0 mV | 0.1 mV | ±5% of setting ±2 mV |

#### Front Panel Output

**Output Impedance:** 50Ω

#### Standard Waveforms

**Minimum Length:** 32 points
**Maximum Length:** 32,736 points

| Waveform | Programmable Parameters |
|---|---|
| sine | number of cycles, phase |
| square | number of cycles, duty cycle |
| ± pulse | number of cycles, delay, rise, fall, high |
| triangle | number of cycles |
| ± sawtooth | number of cycles, duty cycle |
| ± Exponential | exponent |
| gaussian | exponent |
| haversine | number of cycles |
| circle | number of cycles, phase |
| sin x/x | number of cycles |
| noise | |
| lin sweep | $f_{start}/f_{stop}$ ratio |
| log sweep | $f_{start}/f_{stop}$ ratio |
| AM | $f_c/f_m$ ratio, mod. depth, $f_c$ phase, $f_m$ phase |
| SCM | $f_c/f_m$ ratio, $f_c$ phase, $f_m$ phase |
| FM | $f_c/f_m$ ratio, mod. index, $f_c$ phase, $f_m$ phase |

Note: "number of cycles" means the amount of cycles in the pre-defined waveform memory length
Note: the sum of the length's of all the arb's plus the length of standard waveform memory may not exceed the limit of 32,768 points.

#### Arbitrary Waveforms

**Total Memory Length:** 32,768 points
**Vertical Resolution:** 12 bits; 4095 levels (−2048 to +2047)
**Segmentation:** total memory (32K) can be divided in 100 arb's maximum
**Arb Length:** Each arb (1 to 100), has a freely programmable length
**Minimum Length:** 32 points
**Maximum Length:** 32,704 points

#### Arbitrary Waveform Editing

**Editing Tools:** Front panel PM 5150 or optional mouse
**Editing Modes**
**Line:** Draw a straight line between two points
**Vector**
**Add Function:** Draw a triangle between two anchors and one variable point
**Sum Function:** Add a second waveform between two anchors
**Insert Function:** Insert a second waveform between two anchors
**Digital Amplitude:** Vary the amplitude of the signal between the anchors
**Digital Offset:** Vary the offset of the signal between the anchors
**Smooth Function:** The signal between the anchors can be smoothed (factor 0 to 125)
**Mathematics:**
ARB x + ARB y = ARB z
ARB x − ARB y = ARB z
ARB x * ARB y = ARB z

#### Sequence Generator (Optional)

**Max. Number of Sequences:** 100
**Max. Number of Steps in a Sequence:** 1000
**Max. Number of Steps in Entire Instrument Sequence File:** 1000
**Max. Number of Waveforms:** 100
**Max. Number of Burst Cycles Per Sequence Step:** 1,048,575

#### Spectral Purity

(PM 5150 setting: 20 kHz sine wave, 20 MHz sample freq./1000 samples, filter on, 50Ω terminated)
**THD + noise at:** 100 mV: −60 dBc typical
1V: to −65 dBc typical
20V: to −65 dBc typical
(measured in a frequency band 0 - 80 kHz)

#### Waveform Rise/Fall Time

**Less Than:** 20 ns
(PM 5150 setting: square wave, filter off, 10V p-p at 50Ω termination)

#### Analog Filter

User - selectable, 7 MHz, 7th-order low-pass filter

#### Operation/Modulation Modes

**Continuous:** Output runs continuously between selected memory address locations
**Triggered:** Output at start point until triggered, then runs once
**Gated:** As 'Triggered', but output is continuous only until gate signal ends
**Burst:** Each trigger outputs a pre-programmed number of waveform cycles from 1 to 1,048,575
**Toggled:** The output wave is keyed on/off alternatingly by triggers
**RTS:** Front-panel button or external signal interrupts the output wave and instantly returns it to the start level. Then the wave proceeds from this level on.
**Hold:** Front-panel button or external signal stops waveform at present memory location while applied

#### Modulation Trigger Sources

**Internal Programmable:** 0.02s to 10s
**Manual:** TRIG key
**External:** TRIG input

#### Stored Settings

(Non-volatile memory)
**ARB Memory:** 32K
**Front Panel Settings:** 30

#### Special Inputs/Outputs

**External 10 MHz Reference Clock Input**
**Frequency:** 10 MHz ±10 ppm
**Level:** TTL
**Internal 10 MHz Reference Clock Output**
**Frequency:** 10 MHz
**Level:** TTL
**External Sample Clock Input**
**Maximum Frequency:** 20 MHz
**Level:** TTL
**Internal Sample Clock Output**
**Frequency:** 0.1 mHz to 20 MHz
**Level:** TTL
**Trigger Input**
Trigger input for gated, burst and toggled modes
**Maximum Frequency:** 20 MHz
**Level:** TTL
**Return To Start Input**
Input to reset the output signal to zero
**Level:** TTL
**Sum Input**
Input allows external signal to be added to the output
**Impedance:** 50Ω
**Minimum Frequency:** 0 Hz
**Maximum Frequency:** 20 MHz
**Hold**
Input which holds the output at current state
**Level:** TTL
**Sync 1**
Programmable TTL output
**Default Mode:** Pulse at the end of an ARB or STDW period
**Programmable Mode:** Programmable start address and pulse length
**Level:** TTL
**Sync 2**
Programmable TTL output
**Default Mode:** High during an ARB or STDW period
**Programmable Mode:** Programmable start address and pulse length
**Level:** TTL
**Sync 3**
Programmable TTL output
**Default Mode:** Pulse at the end of each sequence step
**Programmable Mode:** Programmable start address and pulse length
**Level:** TTL
**Z Axis Output**
Output to drive Z input of an oscilloscope during EDIT mode
**Level:** Progr. 0 to 9V (open circuit) typical

## PM 5150 20 MS/s Arbitrary Waveform Generator

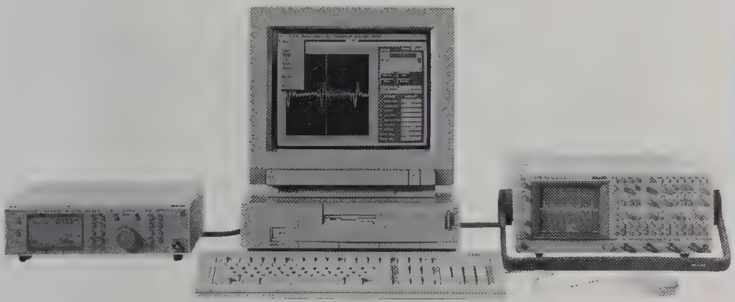
**Impedance:** 75Ω
**Sync Trigger Out**
Output to synchronize two or more ARB generators PM 5150
**Level:** TTL

### Remote Interfaces

**Serial RS-232 Interface**
**Baud Rate:** 1200, 2400, 9600, 19200 baud
**Parity:** None, even, odd
**Data Bits:** 7 or 8
**Stop Bits:** 1 or 2
**Handshake:** Hardware or software
**IEEE Interface**
**Norm:** IEEE-488.2

### Operating Conditions

**Reference Temperature:** 23°C ±3°C
**Operating Temperature:** 0°C to 50°C
**Storage Temperature:** −20°C to +60°C
**EMI:** Meets requirements of VDE 0871 Class B, CISPR 11, EN 55011
**Safety:** Meets requirements of IEC 348 Class 1
**Power Requirements:** 100/120/220/240V
**Line Frequency:** 48 Hz to 63 Hz
**Power Consumption:** 50 VA
**Warm-Up Time:** 20 minutes
**Size:** 315 mm W × 105 mm H × 405 mm D (12.4 in W × 4.13 in H × 15.9 in D)
**Weight:** 6.7 kg (15 lb)



## Ordering Information

### Models

**PM 5150/05n** ARB Generator with 32K Memory, GPIB/IEEE-488 and RS-232 Interface *$3590*
**PM 5150/55n** ARB Generator with 32K Memory, GPIB/IEEE-488 and RS-232 Interface, Sequencer *$4670*

The **n** indicates the required line cord. To select your line cord substitute the **n** by:
1 Universal Euro 220V/16A, 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

### Included with Instrument

Operating manual, power cord and fuse.

**Accessories**
**PM 9515** Mouse *$85*
**PM 9564** 19" Rack Mount Adapter (Europe only)
**PM 2295/10** IEEE-488 Cable, 1m *$190*
**PM 2295/20** IEEE-488 Cable, 2m *$235*
**PM 9536/501** RS-232 Cable, 3m, 9 pin/9 pin fem., with special adapter *$80*
**PM 2273/002** AnyWave Software *$295*

## Customer Support Services

### Factory Warranty

One-year product warranty (three-year product warranty in North America).

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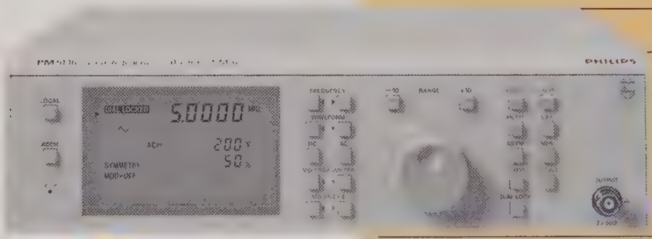
# Function Generators

## PM 5136 Economy 5 MHz Function Generator



PM 5136

New

- Low budget, high performance synthesizer
- In practice proved mechanical and electronic design
- Large backlit display and easy menu controlled operation
- Wide frequency range from 0.1mHz to 5MHz (20Vpp)
- Choice of 7 standard waveforms, includes sine, triangle, square, positive pulse, negative pulse, positive sawtooth and negative sawtooth
- Symmetry continuously variable
- Internal and external modulation modes, includes AM, FM, Linear Sweep, Logarithm Sweep and Burst
- 9 setting memories
- GPIB/IEEE-488.2 interface (optional)

Meeting the need for economic yet high performance, the PM 5136 provides a wide range of operation at an affordable price. This top value generator combines high precision with easy operation making it an ideal choice for applications such as production line testing, bench service, education and training.

## Specifications

### Frequency Characteristics

**Nominal Range:** 0.1 mHz - 5 MHz
**Operational Range:**
**Sine:** 0.1 mHz - 5 MHz
**Square:** 0.1 mHz - 5 MHz
**Pos./Neg. Pulse:** 0.1 mHz - 5 MHz
**Triangle:** 0.1 mHz - 500 kHz
**Pos./Neg. Sawtooth:** 0.1 mHz - 50 kHz
**Resolution:** 4½ digits, max. 0.1 mHz, 10 Hz resolution (fc > 200.00 kHz) via GPIB/IEEE-488.2 interface
**Setting Error:** ± 2 x $10^{-6}$ (± 2 ppm)
**Residual FM:** < 10 ppm, 1 ppm typical
**Temperature Coefficient:** < 0.2 ppm / °C
**Aging:** < 1 ppm / year
**Drift:** < 0.3 ppm in 7 hours
**Synchronization:** by an 10 MHz (or 10 MHz subharmonic)

### Output Characteristics

#### Main Output

**Connector:** BNC socket on front panel
**Impedance:** 50 Ω
**Load Capability:** short circuit proof
**Max. External Voltage:** ± 15 Vpp < 3 min.
**AC Voltage:** independent of DC setting within ± 10 V window
**Ranges (Open Circuit):**
**Range I:** 0 - 0.200 Vpp, resolution 1 mV
**Range II:** 0.20 - 2.00 Vpp, resolution 10 mV
**Range III:** 2.0 - 20.0 Vpp, resolution 100 mV
**Basic Setting Error:**
**$f_c$: 0.1 mHz - 200 kHz** ± 2%
**Amplitude Flatness:**
**$f_c$: 0.1 mHz - 200 kHz** ± 0.1 dB
**$f_c$: 200 kHz - 5 MHz** ± 0.2 dB
**DC Voltage:** Independent of AC setting within ± 10 V window
**Range:** -10 to +10 V, resolution 0.1 V
**Error:** ± 2% ± 50 mV (at 50 Ω load)

#### TTL Output (Rear Panel)

**Fan-out:** < 10 TTL inputs (Zo = 50 Ω)
**Level:** 0 / 5 V

### Waveforms

#### Sinewave

**Frequency Range:** 0.1 mHz - 5 MHz
**Output Range:** 0 - 20 Vpp
**Total Harmonic Distortion**[*2]**:**
**$f_c$: 1 Hz - 500 kHz** < 0.4%, 0.1% typical
**Harmonics**[*2]**:**
**$f_c$: 1 Hz - 500 kHz** < -48 dBc
**$f_c$: 500 kHz - 5 MHz** < -40 dBc
**Subharmonics:**
**$f_c$: 0.1 mHz - 5 MHz** < -60 dBc
**Non Harmonics**[*3]**:**
**$f_c$: 0.1 mHz - 5 MHz** < -37 dBc
**Phase Noise (at 1 kHz Distance from fc):**
**$f_c$: 0.1 mHz - 5 MHz** < -80 dBc/Hz
**Symmetry (Duty Cycle):**
**$f_c$: 0.1 mHz - 20 kHz** 1 - 99%, resolution 1%

#### Square

**Frequency Range:** 0.1 mHz - 5 MHz
**Output Range:** 0 - 20 Vpp
**Transition Times:**
**$f_c$: 0.1 mHz - 500 kHz** ≤ 30 ns
**$f_c$: 500 kHz - 5 MHz** ≤ 20 ns
**Symmetry (Duty Cycle):**
**$f_c$: 0.1 mHz - 20 kHz** 1 - 99%, resolution 1%
**$f_c$: 20 kHz - 5 MHz** 20 - 80%, resolution 1%
**Aberration:** < 2%

#### Positive / Negative Pulse

**Frequency Range:** 0.1 mHz - 5 MHz
**Output Range:** 0 - 10 Vpp
**Transition Times:**
**$f_c$: 0.1 mHz - 500 kHz** ≤ 30 ns
**$f_c$: 500 kHz - 5 MHz** ≤ 20 ns
**Symmetry (Duty Cycle):**
**$f_c$: 0.1 mHz - 20 kHz** 1 - 99%, resolution 1%
**$f_c$: 20 kHz - 5 MHz** 20 - 80%, resolution 1%
**Aberration:** < 2%

#### Triangle

**Frequency Range:** 0.1 mHz - 500 kHz
**Output Range:** 0 - 20 Vpp
**Linearity Error:**
**$f_c$: 0.1 mHz - 20 kHz** < 0.2%
**Symmetry (Duty Cycle):**
**$f_c$: 0.1 mHz - 20 kHz** 1 - 99%, resolution 1%

#### Positive / Negative Sawtooth

**Frequency Range:** 0.1 mHz - 50 kHz
**Output Range:** 0 - 10 Vpp
**Linearity Error:**
**$f_c$: 0.1 mHz - 20 kHz** < 0.2%

### Modulation

#### Internal AM

**Carrier Frequency:** 0.1 mHz - 5 MHz
**Carrier Waveforms:** all
**Modulation Frequency:** 1 kHz ± 0.01%
**Modulation Depth:** 0 - 100%, resolution 1%
**Envelope Distortion:** < 0.5%, 0.2% typical (modulation depth ≤ 90%)

#### External AM

**Modulation Frequency:** 0 - 200 kHz
**Modulation Depth:** 0 - 100%
**Impedance Mod./Trig. Input:** 100 kΩ
**Envelope Distortion:** [0.5%, 0.2% typical (modulation depth ≤ 90%)

#### Internal FM

**Carrier Frequency:** 0.1 mHz - 5 MHz

GPIB
IEEE-488

# Function Generators

## PM 5136 Economy 5 MHz Function Generator

**Carrier Waveforms:** all
**Modulation Frequency:** 1 kHz ± 0.01%
**Deviation:** 0 - 2%, resolution 0.01%
**Modulation Distortion:** 0.12% typical per 1% deviation

### External FM

**Modulation Frequency:** 10 Hz - 200 kHz
**Impedance Mod./Trig. Input:** 100 kΩ
**Deviation:** 0 - 2%

### Internal Burst

**Carrier Frequency:** 0.1 mHz - 2 MHz
**Carrier Waveforms:** all
**On Cycles:** 1 - 2000
**Trigger Frequency:** 1 kHz ± 0.01%

### External Burst

**Trigger Frequency:** 0 - 200 kHz
**Impedance Mod./Trig. Input:** 100 kΩ

### Sweep

**Carrier Waveform:** all
**Sweep Functions:** linear or logarithmic / single or continuous
**Sweep Range:** 1 mHz - 5 MHz
**Sweep Modes:** sweep and fly-back / sweep and hold / sweep and reverse sweep
**Sweep Time:** 0.01 - 1000 s, max resolution 10 ms

### GPIB/IEEE 488.2 Interface Remote Control

**Control Capability:** all functions and characteristics
**Interface Functions:** AH1, L3, SH1, T6, SR1, RL1
**Address:** programmable with rotary knob on front panel
**Address Range:** 0 - 30 and listen only mode
**Remote Lock-Out:** go to local via front panel key "LOCAL"
**Special Functions:** device identification mode / learn mode

### Miscellaneous

**Non-Volatile Memory Instrument Settings:** 1 + 9
**Rear Connectors:** modulation / triggering input / reference input / TTL output / modulation output / penlift output / sweep output / 10 MHz reference output / GPIB/IEEE-488.2 interface connector *1 / power connector
**Dimensions:** 105 x 315 x 405 mm (HxWxD) / 4⅛" x 12⅜" x 16" (HxWxD)
**Weight:** 6.7 kg / 14.7 lbs

### Operating Conditions

**Reference Temperature:** 23 °C ± 1°C
**Operating Temperature:** + 5 .. +40°C
**Storage Temperature:** -40 .. +80°C
**EMI:** Meets requirements of VDE 0871 Class B
**Safety:** Meets requirements of IEC 348 Class 1
**Power Requirements:** 100, 120, 220, 240 V
**Line Frequency:** 50 - 60 Hz ± 5%
**Power Consumption:** 42 W

*[1] Instruments with GPIB/IEEE 488.2 interface

*[2] AC–pp ≥ 20 mV, maximum level ≤ 70% x $U_{range\ max}$, Zo = 50 Ω, $R_l$ = 50 Ω

*[3] 30 kHz band, centered on carrier excluded, AC–pp ≥ 20 mV

## Ordering Information

### Models

**PM 5136/00n** 5 MHz Programmable Function Generator *$2480*
**PM 5136/02n** 5 MHz Programmable Function Generator with GPIB/IEEE-488.2 interface *$2895*
**n** - see power options

### Power Options

The last digit **(n)** of the typenumber PM 5136 is the indication for the local line voltage and local line cord. Following line voltage settings plus line cord are available: EC

| | |
|---|---|
| **n** = 1 | Universal European 220 V |
| **n** = 3 | Standard North American 120V |
| **n** = 4 | United Kingdom 240 V |
| **n** = 5 | Switzerland 220 V |
| **n** = 8 | Australia 240 V |

Example:
PM 5136/021 5 MHz Programmable Function Generator with GPIB/IEEE- 488.2 interface, Universal European line voltage.

### Accessories

**PM 9564** 19 inch Rackmount *$240*
**PM 9581/01** 50 Ω feed-through termination 3 W *$100*
**PM 9585/01** 50 Ω feed-through termination 1 W *$60*
**Y 8021** GPIB/IEEE-488 cable 5 m *$195*
**PM 2295/10** GPIB/IEEE-488 cable 1 m *$190*
**PM 2295/20** GPIB/IEEE-488 cable 2 m *$235*
**PM 2296/50** GPIB/IEEE-488 to IEC-625 adapter (Europe only) *$90*
**PM 9051** BNC to 4 mm banana adapter *$27*

### Manuals

**PM 5136** Operator* *$115*
**PM 5136** Service *$115*

*Included with instrument or appropriate optional configuration

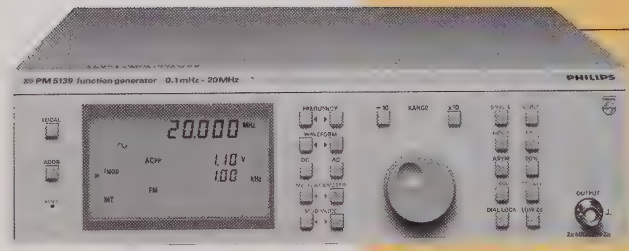
### Customer Support Services

**Factory Warranty**
One-year product warranty.

# Function Generators

## PM 5138A/39 10 MHz/20 MHz Function Generators

- Programmable internal trigger/modulation source 1 mHz to 100 KHz
- Frequency range from 0.1 mHz to 20 MHz (PM 5139) or 10 MHz (PM 5138A)
- 20 Vpp Output (PM 5139) or 40 Vpp Output (PM 5138A)
- 10 standard waveforms (PM 5139) or 7 standard waveforms (PM 5138A)
- Low $Z_o$ or 50Ω Output Impedance (PM 5139)
- 50Ω or 600Ω Output Impedance (PM 5138A)
- Non-volatile memory stores up to 24 user-defined waveforms
- Large backlit LCD display and menu-controlled operation
- Arbitrary waveforms on instruments with GPIB/IEEE-488.2./RS-232 interface
- Internal/external modulation modes include AM, FM, PSK, Sweep, BURST, and GATE



PM 5139

Fluke makes using precision function generation easier than ever with the PM 5138A and PM 5139. These high-performance instruments bring a new concept to waveform generation and frequency synthesis: full menu-driven operation. Just a few push buttons let you select the function you want, and a single, large control knob allows precise setting of all numeric values.

### Fast, Simple and Precise

With these precision instruments, setting up your test signal is faster, simpler and more precise than ever before. At all times, you get a clear indication of the selected signal on the large backlit LCD display. The display gives at-a-glance readout of vital parameters such as frequency, waveform, amplitude, offset and modulation. So you're always fully informed about instrument status, selections and other essential test parameters.

### Step-Through Menu Lines

To change a setting, all that's necessary is to select one of the five menu lines and press the corresponding buttons. In each case, the 'active' parameter is clearly indicated on-screen by an arrow. Then, you can step through the available options, which are highlighted one-by-one on the display. These five menu lines let you make all instrument settings instantly and precisely.

All numeric values such as frequency, offset and modulation depth are set with high precision by the control knob.

### Special Function Selection

Specific function keys are conveniently located in a separate field at the right of the front panel. These keys allow fast selection of function such as single or continuous burst/sweep; hold and external trigger/modulation; asymmetrical waveform with duty cycles variable from 1 to 99%; a 50% key for instant return to

## Specifications

### Technical Specifications

### Frequency characteristics

| | PM 5139 | PM 5138A |
|---|---|---|
| Nominal range | 0.1 mHz - 20 MHz | 0.1 mHz - 10 MHz |
| Resolution | 4½ digits, max. 0.1 mHz<br>10 Hz resolution ($f_c$ > 200.000 kHz) via interface | |
| Setting error | ± 2 × $10^{-6}$ (± 2 ppm) | |
| Residual FM | < 10 ppm, 1 ppm typical ($f_c$ < 10 MHz)<br><100 Hz, 13 Hz typical ($f_c$ > 10 MHz) | < 10 ppm, 1 ppm typical ($f_c$ < 5 MHz)<br>< 100 Hz, 13 Hz typical ($f_c$ > 5 MHz) |
| Temperature coefficient | < 0.2 ppm / °C | |
| Aging | < 1 ppm / year | |
| Drift | < 0.3 ppm in 7 hours | |
| Synchronization | via 10 MHz (or 10 MHz subharmonic) | |

### Main output characteristics

| | PM 5139 | PM 5138A |
|---|---|---|
| Impedance | 50Ω or Low Zo | 50Ω or 600Ω |
| Load capability | short circuit proof | |
| Max. external voltage | ± 15 Vpp < 3 min | ± 20 Vpp |
| AC voltage | independent of DC setting within ± 10V window | independent of DC setting within ± 20V window |
| Ranges (open circuit) | 0 - 0.200 Vpp, resolution 1 mV<br>0.20 - 2.00 Vpp, resolution 10 mV<br>2.0 - 20.0 Vpp, resolution 100 mV | 0 - 0.400 Vpp, resolution 1 mV<br>0.40 - 4.00 Vpp, resolution 10 mV<br>4.0 - 40.0 Vpp, resolution 100 mV |
| Basic setting error [*2] | ± 2.0%, $f_c$ < 200 kHz,<br>0.01 - 20.0 Vpp | ± 2.0%, $f_c$ < 200 kHz,<br>0.02 - 40.0 Vpp |
| Amplitude flatness [*2]<br>$f_c$: 0.1 mHz - 200 kHz<br>$f_c$: 200 kHz - 5 MHz<br>$f_c$: 5 MHz - 10 MHz<br>$f_c$: 10 MHz - 20 MHz | <br>± 0.03 dB typical<br>± 0.05 dB typical<br>± 0.07 dB typical<br>± 0.15 dB typical | <br>± 0.03 dB typical<br>± 0.08 dB typical<br>± 0.18 dB typical |
| DC voltage | independent of AC setting within ± 10V window | independent of AC setting within ± 20V window |
| Range (open circuit) | −10 to +10V | |
| Resolution | 0.1V | |
| Error | ± 2% | |
| Offset error | ± 50 mV (at 50Ω load) | |

## PM 5138A/39 10 MHz/20 MHz Function Generators

symmetrical waveforms, store and recall keys for up to 9 complete front-panel settings; the dial lock key to disable the control knob for numeric settings.

### Wide Choice of Standard Waveforms

The PM 5138A is equipped with a broad library of 7 standard waveforms plus one user-defined arbitrary waveform. The PM 5139 has an extended waveform library offering 10 standard waveforms and 6 stored arbitrary waveforms.

### Wide Choice of Modulation Modes

Extensive modulation capabilities are a strong point of these generators. Modulation modes include AM, FM, PSK, burst, gating and linear or logarithmic frequency sweep. Full modulation capabilities are available for all types of waveforms, including arbitrary waveforms. The modulation source may be internal or external.

Both instruments have an internal modulation source, programmable over the range 10 Hz to 100 kHz, which means that for many applications there is no need for an external modulation source. External modulation sources from dc to 200 kHz can also be used.

### Versatile Burst and Sweep Modes

The burst mode allows a selectable number of cycles to be created at burst trigger frequencies over a 1 mHz to 100 kHz range. The lower trigger frequencies are particularly valuable for mechanical test applications, where intervals as long as 1,000 seconds can be achieved between test cycles. All waveforms, including arbitrary, can be sent as a burst. Frequency sweep mode covers a wide 9½ decade frequency range, with both linear and logarithmic sweeps and variable sweep times from 10 ms to 999 seconds. Three different modes (sweep and flyback, sweep and hold, and sweep up and down) are provided. All waveforms, including arbitrary, may be swept.

### Arbitrary Waveforms

Both the PM 5138A and PM 5139 offer a versatile 'arbitrary' waveform capability, which is a powerful tool for generating custom test signal in GPIB/IEEE-488 or RS-232 system environments. Arbitrary or user-defined waveforms can be created on a PC, and then downloaded to the PM 5138A or PM 5139 via the optional GPIB/IEEE-488.2 or RS-232 interface.

## Waveforms

| | PM 5139 | PM 5138A |
|---|---|---|

### Sine

| | | |
|---|---|---|
| Frequency range | 0.1 mHz - 20 MHz | 0.1 mHz - 10 MHz |
| Output range | 0 - 20 Vpp | 0 - 40 Vpp |
| Total harmonic distortion [*2]<br>$f_c$: 0.1 mHz - 500 kHz | < 0.4%, 0.1% typical, 5.0 - 20.0 Vpp | < 0.4%, 0.1% typical, 10.0 - 40.0 Vpp |
| Harmonics [*2]<br>$f_c$: 1 Hz - 500 kHz<br>$f_c$: 500 kHz - 5 MHz<br>$f_c$: 5 MHz - 10 MHz<br>$f_c$: 10 MHz - 20 MHz | < -48 dBc, 0.02 - 14.0 Vpp<br>< -40 dBc, 0.02 - 14.0 Vpp<br>< -36 dBc, 0.02 - 14.0 Vpp<br>< -34 dBc, 0.02 - 14.0 Vpp | < -42 dBc, 0.04 - 40.0 Vpp<br>< -34 dBc, 0.04 - 40.0 Vpp<br>< -30 dBc, 0.04 - 40.0 Vpp |
| Subharmonics [*2]<br>$f_c$: 1 Hz - 5 MHz<br>$f_c$: 5 MHz - 10 MHz<br>$f_c$: 10 MHz - 20 MHz | < -60 dBc, 0.02 - 20.0 Vpp<br>< -60 dBc, 0.02 - 20.0 Vpp<br>< -38 dBc, 0.02 - 20.0 Vpp | < -60 dBc, 0.04 - 40.0 Vpp<br>< -38 dBc, 0.04 - 40.0 Vpp |
| Non harmonics [*2] [*3]<br>$f_c > 1$ Hz | < -37 dBc, 0.02 - 20.0 Vpp | < -37 dBc, 0.04 - 40.0 Vpp |
| Phase noise (at 1 kHz distance from $f_c$) [*2]<br>$f_c > 0.1$ mHz | < -80 dBc/Hz | |
| Symmetry (duty cycle)<br>$f_c$: 0.1 mHz - 20 kHz | 1 - 99%, resolution 1% | |

### Square, positive / negative pulses

| | | |
|---|---|---|
| Frequency range | 0.1 mHz - 20 MHz | 0.1 mHz - 10 MHz |
| Output range | 0 - 20 Vpp, square<br>0 - 10 Vpp, positive / negative pulses | 0 - 40 Vpp, square<br>0 - 20 Vpp, positive / negative pulses |
| Transition times [*2] [*4]<br>$f_c$: 0.1 mHz - 500 kHz<br>$f_c > 500$ kHz | ≤ 30 ns<br>≤ 20 ns | |
| Symmetry (duty cycle)<br>$f_c$: 0.1 mHz - 20 kHz<br>$f_c$: 20 kHz - 5 MHz | 1 - 99%, resolution 1%<br>20 - 80%, resolution 1% | |
| Aberration [*2] | < 2%, 0.10 - 20.0 Vpp | < 2%, 0.20 - 40.0 Vpp |

### Triangle

| | | |
|---|---|---|
| Frequency range | 0.1 mHz - 500 kHz | 0.1 mHz - 500 kHz |
| Output range | 0 - 20 Vpp | 0 - 40 Vpp |
| Linearity error<br>$f_c < 20$ kHz | < 0.2% | < 0.2% |
| Symmetry (duty cycle)<br>$f_c$: 0.1 mHz - 20 kHz | 1 - 99%, resolution 1% | |

### Positive / negative sawtooth

| | | |
|---|---|---|
| Frequency range | 0.1 mHz - 50 kHz | 0.1 mHz - 50 kHz |
| Output range | 0 - 10 Vpp | 0 - 20 Vpp |
| Linearity error<br>$f_c < 20$ kHz | < 0.2% | < 0.2% |

### Sine pulse, triangle pulse, haversine

| | | |
|---|---|---|
| Frequency range | 0.1 mHz - 50 kHz | |
| Output range | 0 - 10 Vpp | |

### Arbitrary [*1]

| | |
|---|---|
| Frequency range | 0.1 mHz - 20 kHz |
| Maximum sample frequency | 20.48 MHz |
| Sample addresses (x) | 1024 (10 bits) |
| Sample levels (y) | 1024 (10 bits) |
| Programmable | via interface with a PC — or — direct with a DSO without a PC |

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**The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.*

## PM 5138A/39 10 MHz/20 MHz Function Generators

A waveform captured by a Digital Storage Oscilloscope can be transferred to a PC and modified using the PM 2273 AnyWave software package. This package is a powerful tool for creating, capturing and modifying the desired signals, and transferring them quickly and easily to the function generator.

Alternatively, any desired waveform can be captured from a test system using a Fluke Digital Storage Oscilloscope, and then transferred to the PM 5138A or PM 5139 without the need for a PC. The amplitude and frequency of the captured waveform can be varied using the control knob of the function generator, and even modulation modes like AM, FM, gate, sweep and burst can be added to the captured waveform. This makes it very easy to generate a single shot in the arbitrary mode, or to sweep an arbitrary waveform.

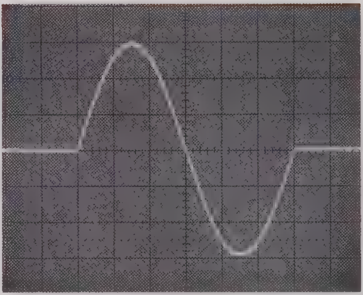
There is no need to enter complex parameters; just select the modulation mode and parameters you want, or add a dc offset to the arbitrary waveform by selecting the dc offset function.

### Optional GPIB/IEEE-488.2 or RS-232 Programmability

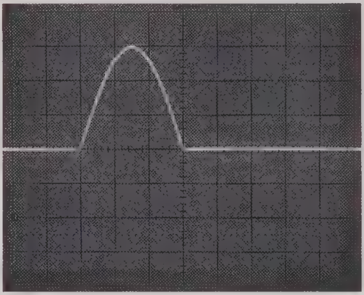
The PM 5138A and PM 5139 are optionally available with a factory-fitted GPIB/IEEE-488.2 or RS-232 interface that provides true system performance.

Carrier frequencies may be programmed over the bus with resolution of 10 Hz (in the upper two frequency ranges) providing the resolution required for systems applications. The built-in non-volatile memory for 9 complete front-panel settings can also be activated under remote control, which can speed and simplify the programming of frequency used test routines.

### Waveforms

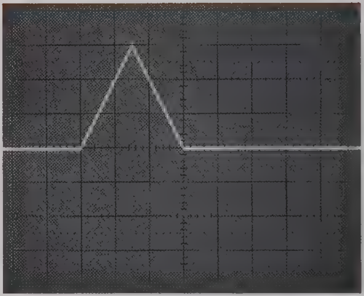


Symmetry (1% resolution)



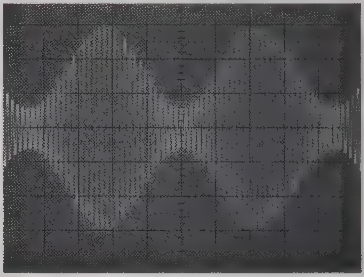
Sine Pulse (PM 5139 only)

**Sine Pulse (PM 5139 only)**
**Frequency Range:** 0.1 mHZ to 50 kHz
**Output Range:** 0 to 10V p-p



Triangle Pulse (PM 5139 only)

**Haversine (PM 5139 only)**
**Frequency Range:** 0.1 mHz to 50 kHz
**Output Range:** 0 to 10V p-p

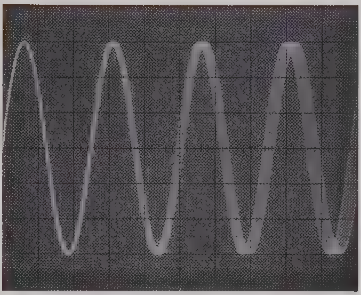


AM

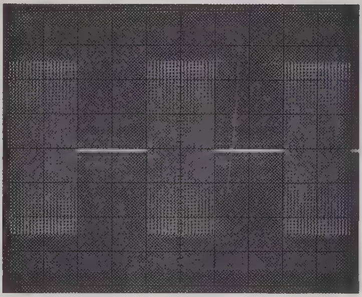
## PM 5138A/39 10 MHz/20 MHz Function Generators

### Modulation

| | PM 5139 | PM 5138A |
|---|---|---|
| **Internal AM** | | |
| Carrier frequency | 0.1 mHz - 20 MHz | 0.1 mHz - 10 MHz |
| Carrier waveforms | all, incl. arbitrary [*1] | |
| Modulation frequency | 10 Hz - 100 kHz, max. resolution 1 Hz | |
| Accuracy | ± 0.1% | |
| Modulation depth | 0 -100%, resolution 1% | |
| Envelope distortion | < 0.5%, 0.2% typical ($f_c$ < 5 MHz, mod. depth ≤ 90%) | < 0.4%, 0.15% typical ($f_c$ ≤ 1 MHz, mod. depth ≤ 90%) |
| **External AM** | | |
| Modulation frequency | 0 - 200 kHz | |
| Modulation depth | 0 - 100% | |
| Impedance modulation / trigger input | 100 kΩ | |
| Envelope distortion | < 0.5%, 0.2% typical ($f_c$ < 5 MHz, mod. depth ≤ 90%) | not specified |
| **Internal FM** | | |
| Carrier frequency | 0.1 mHz - 20 MHz | 0.1 mHz - 10 MHz |
| Carrier waveforms | all, incl. arbitrary [*1] | |
| Modulation frequency | 10 Hz - 100 kHz, max. resolution 1 Hz | |
| Accuracy | ± 0.1% | |
| Deviation | 0 - 2%, resolution 0.01% | |
| Modulation distortion | 0.12% typical per 1% deviation | 0.2% typical per 1% deviation |
| **External FM** | | |
| Modulation frequency | 10 Hz - 200 kHz | 10 Hz - 100 kHz |
| Impedance modulation / trigger input | 100 kΩ | |
| Deviation | 0 - 2% | |
| **Internal gate** Non-phase-coherent signal keying | | |
| Carrier frequency | 0.1 mHz - 20 MHz | 0.1 mHz - 10 MHz |
| Carrier waveforms | all, incl. arbitrary [*1] | |
| Modulation frequency | 10 Hz - 100 kHz, max. resolution 1 Hz | |
| Accuracy | ± 0.1% | |
| Duty cycle | 50% | |
| **External gate** | | |
| Modulation frequency | 0 - 200 kHz (TTL signal) | |
| Impedance modulation / trigger input | 100 kΩ | |
| **Internal PSK** Phase Shift Keying (0/π) | | |
| Carrier frequency | 0.1 mHz - 20 MHz | 0.1 mHz - 10 MHz |
| Carrier waveforms | sine, square and triangle | |
| Modulation frequency | 10 Hz - 100 kHz, max. resolution 1 Hz | |
| Accuracy | ± 0.1% | |
| Duty cycle | 50% | |
| **External PSK** | | |
| Modulation frequency | 0 - 200 kHz (TTL signal) | |
| Impedance modulation / trigger input | 100 kΩ | |



FM or sweep



GATE: non-phase coherent signal keying

# PM 5138A/39 10 MHz/20 MHz Function Generators

## Modulation

| | PM 5139 | PM 5138A |
|---|---|---|
| **Internal burst** Phase coherent signal keying | | |
| Carrier frequency | 0.1 mHz - 2 MHz | |
| Carrier waveforms | all, incl. arbitrary [*1] | |
| On cycles | 1 - 2000 | |
| Start phase | −180° to +180° for sine and triangle, $f_c \le 20$ kHz<br>0° for other waveforms, $f_c > 20$ kHz | |
| Trigger frequency | 1 mHz - 100 kHz, max. resolution 1 mHz | |
| Accuracy | ± 0.1% | |
| **External burst** | | |
| Trigger frequency | 0 - 200 kHz | |
| Impedance modulation / trigger input | 100 kΩ | |
| **Sweep** | | |
| Carrier waveform | all, incl. arbitrary [*1] | |
| Sweep functions | linear or logarithmic / single or continuous | |
| Sweep ranges | 1 mHz - 10 MHz | 1 mHz - 5 MHz |
| | 50 kHz - 20 MHz | 50 kHz - 10 MHz |
| Sweep modes | sweep and fly-back, sweep and hold, sweep and reverse sweep | |
| Sweep time | 0.01 - 1000 s, max resolution 10 ms | |

## Interface bus remote control

**Isolation:** In- and outputs galvanically separated with opto-couplers

**Control capability:** All functions and characteristics

**Special functions:** Device identification and learn mode

**Communication settings:** Programmable with rotary knob on front panel

**Remote lock-out:** Go to local via front panel

**GPIB/IEEE-488.2**
- **Range:** 0 - 30 and listen only mode

**RS-232C**
- **Baud rate:** 110-19200
- **Data bits:** 7 or 8
- **Stop bits:** 1, 2 for 110 baud
- **Parity:** Odd, even or no parity check
- **Handshake:** Hardware or software (Xon/Xoff)

## General Specifications

**Non-volatile memory**
- **Instrument settings:** 1+ 9
- **Arbitrary waveforms** [*1]**:** 24

**Rear connectors:**
- Modulation input / triggering input / reference input /
- TTL output / modulation output / penlift output / sweep output /
- 10 MHz reference output / interface bus connector [*1] / power connector

**Dimensions:** 105× 315× 405 mm (H×W×D) 4⅛"× 12⅜"× 16" (H×W×D)

**Weight:**
6.7 kg, 14,6 kbs (PM 5139)
6.1 kg, 13.4 lbs (PM 5138A)

## Operating conditions

**Reference temperature:** 23°C± 1°C
**Operating temperature:** + 5 ..+40°C
**Storage temperature:** -40 ..+70°C

**EMI:** Meets requirements of VDE 0871 Class B

**Safety:** Meets requirements of IEC 348 Class 1

**Power requirements:** 100,120,220,240V

**Line frequency:** 50 - 60 Hz± 5

**Power consumption:** 58W (PM 5139); 66W (PM 5138A)

[*1] Instruments with interface
[*2] $Z_o = 50\Omega$, $R_l = 50\Omega$, Modulation off
[*3] 30 kHz band centred on carrier and frequencies> 100 MHz excluded
[*4] 50 % symmetry

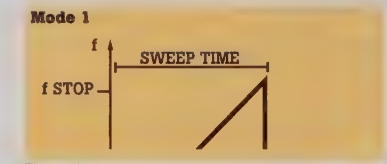


Figure 1.

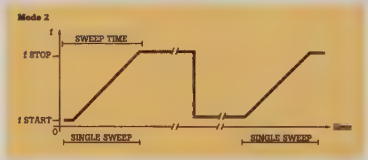


Figure 2.

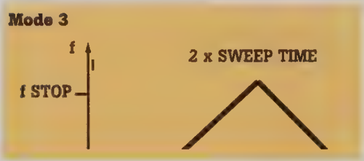


Figure 3.

## Ordering Information

### Models

**PM 5138A/10m** 10 MHz Programmable Function Generator ***$3775***
**PM 5138A/12m** including GPIB/ IEEE-488.2 interface and Arbitrary Waveform ***$4250***
**PM 5138A/13m** including RS-232C interface and Arbitrary Waveform ***$4250***
**PM 5139/00n** 20 MHz Programmable Function Generator ***$4395***
**PM 5139/02n** including GPIB/IEEE-488.2 interface and Arbitrary Waveform ***$4845***
**PM 5139/03n** including RS-232C interface and Arbitrary Waveform ***$4845***

### Power options

**n = 1** Universal European 220V
**n = 3** Standard North American 120V
**n = 4** United Kingdom 240V
**n = 5** Switzerland 220V
**n = 8** Australia 240V

### Accessories

**PM 9564** 19 inch Rackmount for PM 5138A and PM 5139 ***$240***
**PM 9581/01** 50Ω feed-through termination 3W ***$100***
**PM 9585/01** 50Ω feed-through termination 1W ***$60***
**Y 8021** GPIB/IEEE-488 cable 0.5m ***$195***
**PM 2295/10** GPIB/IEEE-488 cable 1 m ***$190***
**PM 2295/20** GPIB/IEEE-488 cable 2 m ***$235***
**PM 2296/50** GPIB/IEEE-488 to IEC-625 adapter (Europe only) ***$90***
**PM 9536/041** RS-232 cable 3m ***$55***
**PM 9051** BNC to 4 mm banana adapter ***$27***

### Manuals

**PM 5138** Operator* - P/N 948260 ***$85***
**PM 5138** Service - P/N 948328 ***$85***
**PM 5139** Operator* - P/N 948265 ***$85***
**PM 5139** Service - P/N 173184 ***$10***
**PM 5139** Programming Card
**No charge with purchase of unit*

### Customer Support Services

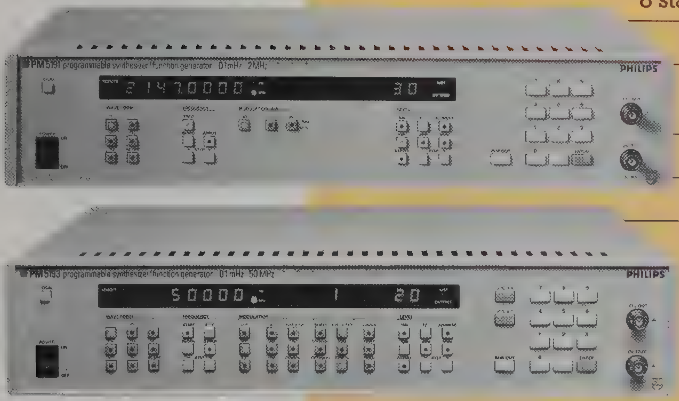
#### Factory Warranty

One-year product warranty.

# Function Generators

## PM 5191 & PM 5193 Synthesized Function Generators

- Wide frequency ranges: 0.1 mHz to 2.147 MHz, or 50 MHz
- 8 standard waveforms (PM 5193) or 5 waveforms (PM 5191)
- 8 Digit Frequency Resolution
- Maximum 20V p-p output (PM 5191: 30V p-p) plus TTL output
- Independent amplitude and offset
- GPIB/IEEE-488 interface standard
- Modulation facilities including AM (both models) FM, Gate Sweep, and Burst (PM 5193)
- Video modulation facilities with model PM 5193V
- 10 MHz external synchronization with models PM 5191S, PM 5193S


PM 5191 programmable synthesizer/function generator 0.1mHz 2MHz
PHILIPS
PM 5193 programmable synthesizer/function generator 0.1mHz 50MHz
PHILIPS

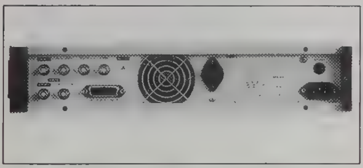
PM 5191/93

If you need precision, versatility and value in a waveform generator, Fluke offers a complete line of instruments that covers your requirements – exactly. Choose from the top-of-the-line PM 5193, with its 50 MHz frequency range, or the economical PM 5191, with excellent performance up to 2.147 MHz.

Each model offers you a comprehensive choice of waveform functions - up to eight on the PM 5193. AM, FM, gating and burst modes extend flexibility, and all can be driven either internally by the generator, or by an external source. Linear and logarithmic sweep with fully independent start and stop frequencies and sweep times can also be programmed. Three different sweep modes (sweep and flyback, sweep and hold, sweep up and down) are available. Add to this flexibility the precision of 8-digit resolution and high long-term stability, thus ensuring total reproducibility of your test routines.

### PM 5193: The Most Versatile 50 MHz Performance

The PM 5193 offers complete versatility of performance, and a wide array of features to meet both today's and tomorrow's requirements. Complete in frequency range, it has exceptional 11½-decade coverage and setting accuracy of better than 0.1 mHz. A choice of eight waveforms that includes sine, square, ramps and haversine, plus a built-in pulse generator for positive and negative pulses with 3 ns transition times. AM, FM, gating and counted burst modulation, with programmable single-shot or continuous operation, and programmable internal (to 200 kHz), or external modulation. Sweep facilities, with linear and logarithmic sweep and three sweep modes, which can be controlled internally (single or continuous) or by an external trigger. The PM 5193 can store ten setup and features full GPIB/IEEE-488* programmability.



If you're budgeting for a 'standard' synthesizer/function generator, the PM 5193 offers you complete performance for about the same price. Compare and see how the PM 5193 can address today's applications such as digital communications, calibration and state-of-the-art electronics – with the versatility to meet tomorrow's applications as well.

### PM 5191: The Value Leader

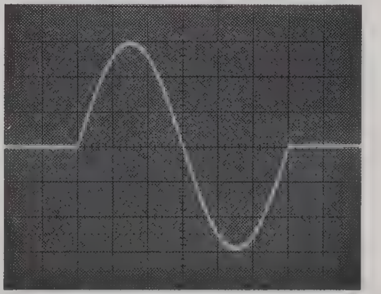
The PM 5191 brings 8-digit precision and repeatability and full IEEE-488 programmability to budget-conscious engineers. A full 10-decade frequency range (From 0.1 mHz to 2.147 MHz), five standard waveforms and internal or external AM make this a versatile general-purpose instrument. Internal modulation (1 kHz) uses any waveforms as a carrier, while external AM modulation covers a 200 kHz range. The carrier frequency is variable over the instrument's entire frequency range from 0.1 mHz up to 2.147 MHz.

The PM 5191 also offers phase noise of –80 dBc/Hz and a high 30V pp output level.

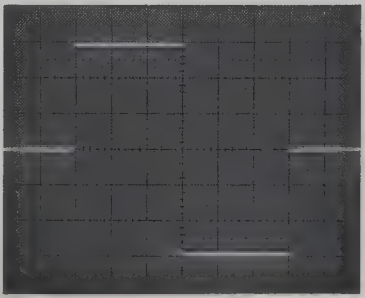
With this outstanding combination of performance and value, the PM 5191 is well-suited for lab or production line use, as well as for education and training.

### Wide Choice of Standard Waveforms

Each instrument offers a wide choice of standard waveform functions: eight for the PM 5193, and five for the PM 5191. All functions are selectable either through the front panel or the IEEE-488 interface. LED indicators to show at a glance which function is selected. Out-of-range or invalid settings are indicated by blinking LED indicators, simplifying the front panel and the bus interface.



Sine wave



Square wave

GPIB IEEE-488

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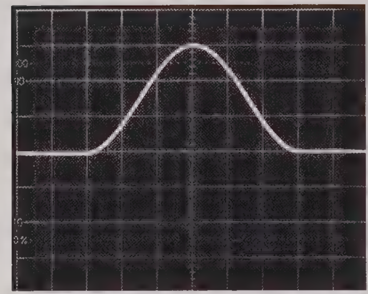
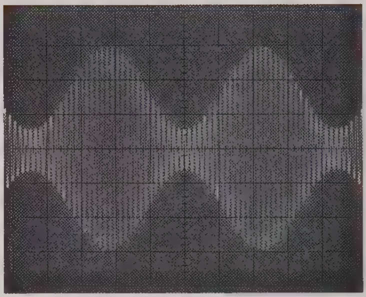
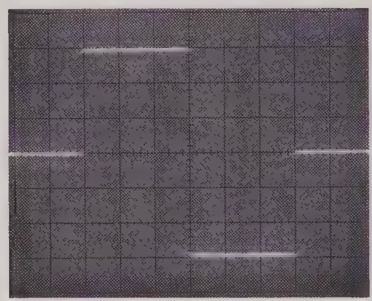
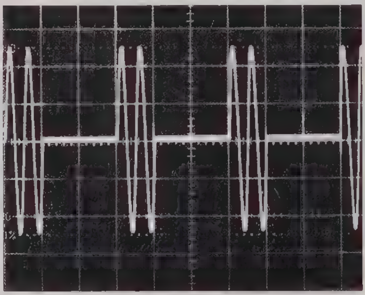
*The terms GPIB and IEEE-488 may be used interchangeably throughout this catalog.

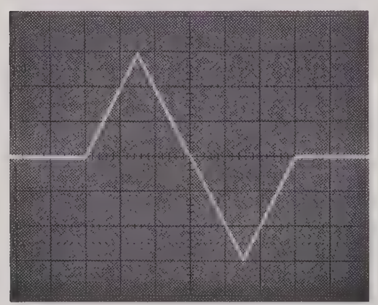
# PM 5191 & PM 5193 Synthesized Function Generators

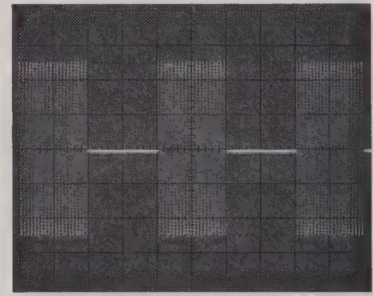

Sine wave

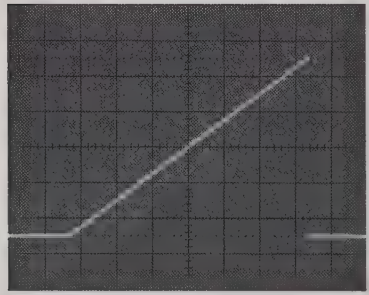

Carrier wave with amplitude modulation; 100% modulation depth

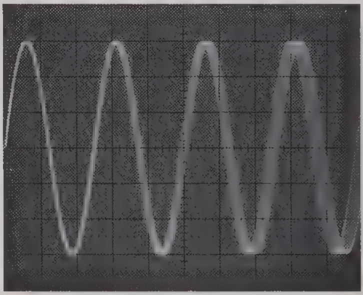

Positive and negative pulses with 3 ns transition time (PM 5193 only)


Burst signal, programmable on/off cycles; 2 on, 4 off cycles (PM 5193 only)


Triangle


Gated signal; non-phase-coherent on/off keying (PM 5192/PM 5193 only)


Positive and negative ramps


Oscillogram showing frequency sweep or frequency modulation (PM 5192/PM 5193 only)

## Instantly Selectable Modulation Modes

All modulation modes are available at the touch of a button. Modes include AM, FM, burst and gating. For sweeps you have a choice of linear or logarithmic sweep and a selection of sweep modes: sweep and re-trace, sweep up - sweep down, or sweep-and-hold.

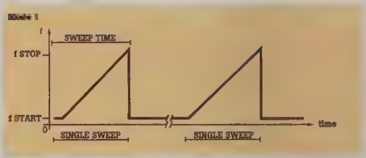

Mode 1
f
SWEEP TIME
f STOP
f START
0
time
SINGLE SWEEP
SINGLE SWEEP

Figure 1.

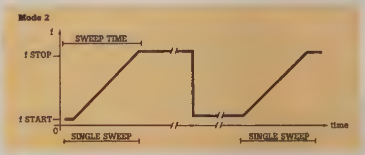

Mode 2
f
SWEEP TIME
f STOP
f START
0
time
SINGLE SWEEP
SINGLE SWEEP

Figure 2.

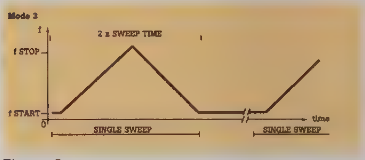

Mode 3
f
2 x SWEEP TIME
f STOP
f START
0
time
SINGLE SWEEP
SINGLE SWEEP

Figure 3.

## Precise Frequency Programming

The frequency keypad area allows precise programming of all frequency-related settings, including scale (Hz/kHz) and frequency steps. These preset frequency steps allow incremental frequency changes with the step + or - buttons.

## Versatile Output Level Setting

The desired output levels in V pp, V rms or dBm can be selected by the keypad, while the selected output voltage is indicated on the LED display. A step function allows quick changes in output level in preset-table steps.

Specially developed circuitry prevents any interaction between ac and dc settings. The signal outputs, including the TTL output, are short-circuit proof.

# Function Generators

## PM 5191 & PM 5193 Synthesized Function Generators

### Full GPIB/IEEE-488 Programmability Adds Extra Versatility

The full IEEE-488 programmability of all these synthesizer/function generators adds an important extra dimension to their versatility.

Built-in Learn and Identification modes speed and simplify IEEE-programming. In Learn mode, complete strings representing front-panel settings can be transmitted to the controller. The same instrument set-up can be reproduced whenever required, simply by re-transmitting the same string. In the Identification mode, the instrument automatically responds to an identification request from the controller by transmitting its type number and software version.

### 10 MHz External Synchronization

In many applications where frequency synthesizers are used, synchronizing the outputs of two or more synthesizers makes it possible to have signals of exactly the same frequency, precisely determined frequency ratios or phase-lock.

The PM 5191 and PM 5193 synthesizers use the same synchronization frequency of 8.6 MHz, allowing convenient synchronization of any combination of these instruments.

For applications demanding traceability to an external standard, the PM 5191S and PM 5193S generators can be synchronized with external standards at 10 MHz, or sub-harmonics such as 1, 2 or 5 MHz.

Note: Phase locking to other 10 MHz instruments using the external reference is not possible.

### Quick Selection Guide

| | PM 5191 | PM 5193 |
|---|---|---|
| Maximum Frequency | 2 MHz | 50 MHz |
| Waveforms | 5 | 8 |
| Output Voltage Vp-p | 30 | 20 |
| Internal Modulation | 1 kHz | 10 Hz - 200 kHz |
| INT/EXT AM | y | y |
| INT/EXT FM | – | y |
| INT/EXT SATE | – | y |
| Sweep | – | y |
| Burst | – | y |
| Front Panel Setups | 1 | 10 |

### Video Modulation Facilities

The PM 5193V adds video modulation facilities to the wide range of waveforms and modulation facilities of the standard instrument. In this version, video modulation is provided by an external modulation signal, and replaces the AM external modulation mode of the PM 5193.

## PM 5193 Specifications

### Technical Specifications

### Frequency and Characteristics

**Nominal Range:** 0.1 mHz to 50 MHz
**Operational Range:** Sine wave 50 MHz
Positive pulse 50 MHz
Negative pulse 50 MHz
Square wave 20 MHz;
Triangle 200 kHz;
Haversine 50 kHz
Positive sawtooth 20 kHz;
Negative sawtooth 20 kHz
**Setting:** Local via front-panel keyboard. Remote via IEEE-488 bus interface. ± stepping function with programmable step width.
**Resolution:** 8 digits; >0.1 mHz
**Display:** 8-digit LED display, Hz/kHz indication
**Setting Error:** $<1 \times 10^{-6}$
**Frequency Jitter:** 0.02%, <1200 Hz; f ≥2 MHz, LF bandwidth 10 Hz to 20 kHz
**Temperature Coefficient:** <0.2 ppm/K
**Aging:** <1 ppm per year
**Drift:** <0.3 ppm in 7 hours

### Output Characteristics

**Connector:** BNC socket on front or rear panel
**Impedance:** $Z_0 = 50\Omega$
**Load Capability:** Short-circuit proof
**Maximum External Voltage:** ±12V p-p (<3 min.)

### AC Voltage

Independent of dc settings within ±10V window
**Ranges:** Range l 2.1 to 20V p-p open-circuit voltage; Range ll 0.21 to 2.00V p-p open-circuit voltage; Range lll 0 to .200V p-p open-circuit voltage
**Resolution:** Range 1 0.1V; Range ll 0.01V; Range lll 0.001V
**Setting:** Remote or local +/– stepping Programmable step width
**Alternative Settings:** V rms, dBm
**Basic Setting Error:** ±2% (1 Hz to 200 kHz) V p-p >2.1V

### DC Voltage

Independent of ac setting within ±10V window
**Range:** ±10V open-circuit voltage
**Resolution:** 0.1V
**Error:** ±2% of setting
**Offset:** <0.03V (Vac ≤2V); <0.08V (Vac >2V)
**Setting:** Remote or local; +/– stepping function. Programmable step width.

### TTL Output

**Connector:** BNC socket on front panel
**Fan-Out:** 5 TTL inputs
**Level:** 0/>3.5V

### Waveforms

**Standard Functions:** Sine wave, square wave, triangle, haversine, sawtooth (positive- and negative-going ramps), positive and negative pulse
**Selection:** Local via front panel keyboard. Remote via GPIB/IEEE-488 bus interface.
**Indication:** Key LEDs

### Sine Wave

**Frequency Range:** 0.1 mHz to 50 MHz
**Output Range:** 0 to 20V p-p

### Distortion

**THD:** typ. 0.2%, <0.5% (f = 1 Hz to 200 kHz) typ. 0.4%, <0.7%, (f = 200 kHz to 2 MHz)
**Harmonics:** <–34 dBc (f≤10 MHz, Vp-p ≥10 mV)
**Spurious:** <–40 dBc (2 MHz< f <50 MHz, open circuit voltage ≥100 mV p-p, distance from carrier >15 kHz); <–50 dBc (0.1 mHz< f <2 MHz, open circuit voltage ≥100 mV p-p)

### Haversine

**Frequency Range:** 0.1 mHz to 50 kHz
**Output Range:** 0 to 10V p-p
**Distortion:** <0.8% (output >10 mV p-p)

### Square Wave

**Frequency Range:** 0.1 mHz to 20 MHz
**Transition Times:** 10 ns typically, <11.5 ns
**Duty Cycle:** 50%
**Aberration:** <2% ±20 mV range l; <2% ±3 mV range ll

### Triangle

**Frequency Range:** 0.1 mHz to 200 kHz
**Output Range:** 0 to 20V p-p
**Temperature Coefficient:** <0.1%/K
**Linearity:** >99%

### Sawtooth (pos/neg ramps)

**Frequency Range:** 0.1 mHz to 20 kHz
**Output Range:** 0 to 10V p-p
**Temperature Coefficient:** <0.1%/K
**Flyback Time:** <1 µs
**Linearity:** <99%

### Pulse

**Frequency Range:** 0.1 mHz to 50 MHz
**Output Range:** 1.0 to 10V p-p
**Rise/Fall Time:** 3 ns typical, <4.5 ns
**Aberration:** <2% ±40 mV

### Modulation

**Modes:** AM int /ext, FM int/ext, lin/log sweep, gate int/ext, burst. Internal modulation frequency programmable via keypad.
**Resolution:** Range l (0.01 to 0.99 kHz): 10 Hz
Range ll (1.0 to 9.9 kHz): 0.1 kHz
Range lll (10 to 200 kHz): 1.0 kHz

### Internal AM

**Carrier Frequency:** 0.1 mHz to 50 MHz
**Carrier Wave:** All, except pulses
**Modulation Frequency:** 10 Hz to 200 kHz
**Modulation Depth:** 0 to 100%
**Resolution:** 1%
**AM Envelope Distortion:** <2% (m ≤98%); <1.5% (m <50%, fm 100 Hz to 20 kHz)

## PM 5191 & PM 5193 Synthesized Function Generators

### External AM

**Modulation Frequency:** 0 to 200 kHz
**AM Envelope Distortion:** 2% (m <98%); 1.5% (m<50%; fm 100 Hz to 20 kHz)

### Internal FM

**Carrier Frequency:** >2 MHz
**Modulation Frequency:** 10 Hz to 200 kHz
**Deviation:** 10 kHz to 200 kHz
**Resolution:** 1 kHz
**Modulation Distortion:** <1% (f ≤30 MHz; Df ≤100 kHz; fm ≥200 Hz to ≤50 kHz)

### External FM

**Carrier Frequency:** >2 MHz
**Modulation Frequency:** 10 Hz to 200 kHz
**Deviation:** 10 kHz to 200 kHz
**Distortion:** <1%

### Sweep

**Carrier Wave:** All waveforms
**Sweep Functions:** lin/log, up/down, single/continuous, hold/release
**Range:** 1 mHz to 50 MHz phase-continuous, depending on waveform; independent setting of start and stop frequencies
**Sweep Time:** 10 ms to 999s
**Resolution:** Maximum 0.01s (3 digits)
**Error:** 0.1 ms, sweeptime ≤4s

### Internal Gate

Non phase-coherent signal keying
**Carrier Frequency:** 0.1 mHz to 50 MHz (depending on waveform): carrier wave: all except pulses
**Modulation Frequency:** 10 Hz to 200 kHz
**Duty Cycle:** 50%

### External Gate

**Modulation Frequency:** 0 to 500 kHz; min on/off time 2 µs

### Burst

**Carrier Frequency:** 2 MHz all carrier waveforms
**On and Off Cycles:** 1 to 200 programmable
**Burst Functions:** Single/continuous
**External Triggering:** TTL positive edge; via modulation input
**Maximum Repetition Rate:** 1 kHz

### Video Modulation (PM 5193V only)

**Carrier Waveform:** Sine
**Carrier Frequency:** ≤50 MHz
**Modulation Bandwidth (−1 dB):** ≥8 MHz; carrier frequency <45 MHz
**External Modulation Signal:** CVBS; amplitude: 1V p-p
**Maximum DC Offset:** ±5V
**Modulation Mode:** Double sideband amplitude modulation (A3F), negative polarity
**RF Synchronizing Level:** 100%
**Residual Level (white level):** 11 ±3%; related to RF synchronizing level
**Independent Linearity Error:** ≤2% between black and white level
**Connector:** BNC; "VIDEO IN" at rear of the instrument
**Impedance:** 75Ω

### GPIB/IEEE-488 Bus Remote Control

**Control Capability:** All signal functions and characteristics
**Interface Functions:** AH1, L4, RL1, SR1, SH1, T6
**Listener Address:** Programmable via keyboard, indicated by LED display
**Address Range:** 0 to 30
**Service Request:** Error and single end message
**Remote Lock-Out:** Go-to local front panel key. Device identification and learn modes provided as standard.

### 10 MHz Output (PM 5193S only)

**Protection:** Short-circuit proof, maximum external voltage 10V
**Frequency:** 10 MHz (squarewave)
**Level:** Typical 2 dBm >0 dBm
**Impedance:** 50Ω

### External Reference Input (PM 5193S only)

**Maximum Voltage:** ±5V
**Waveform:** Sine or square
**Frequency:** 10 MHz N = 1,2,3 to 10 for N Synchronization purposes <2s
**Lock-In Range:** ±0.1% – a relative frequency offset of the reference frequency, results in the same relative offset of the output frequency
**Level:** 0 to 20 dBm
**Impedance:** 50Ω

*Note: It is not possible to phase lock with other 10 MHz instruments*

### General Specifications

#### Miscellaneous

**Non-Volatile Memory:** 1 memory location for last setting. 9 memory locations for programmable settings.
**Rear Connectors:** Modulation output BNC; Sweep output BNC; Pen-lift output BNC; Clock output BNC; Modulation Input BNC; Clock input BNC; GPIB/IEEE-488 bus connector; Mains connector

#### Operating Conditions

**Reference Temperature:** +23°C ±1°C
**Operating Temperature:** +5°C to +40°C
**Storage Temperature:** −20°C to +70°C

#### Power Requirements

**Line Voltage:** 100V, 120V, 220V, 240V, tolerance ±10%
**Line Frequency:** 50 Hz to 60 Hz, tolerance ±5%
**Power Consumption:** 105W

#### Mechanical Data

**Size:** 105 mm H × 440 mm W × 430 mm L (4.1 in H × 17.3 in W × 15.6 in L), rack mounting facility standard (2 units high)
**Weight:** 10.5 kg (23 lb)

## Ordering Information

### Models

#### U.S. Versions

**PM 5193M** Programmable Synthesizer/Function Generator ***$6000***
**PM 5193SM** Programmable Synthesizer/Function Generator with 10 MHz Reference Input ***$6335***
**PM 5193VM** Programmable Synthesizer/Function Generator with Video Modulation ***$7600***

#### European Versions

**PM 5193** Programmable Synthesizer/Function Generator ***$6000***
**PM 5193S** Programmable Synthesizer/Function Generator with 10 MHz Reference Input ***$6335***
**PM 5193V** Programmable Synthesizer/Function Generator with Video Modulation ***$7600***

**Included with Instrument**
One-year product warranty, line cord, rack mounting brackets, programming card, Operator's manual and Certificate of Calibration Practices.

### Option

**Rear Panel Output**

### Accessories

**PM 9051** BNC to 4 mm Banana Adapter ***$27***
**PM 9551** 50Ω to 600Ω Adapter ***$105***
**PM 9581/01** 50Ω Feedthrough Termination 3W ***$100***
**PM 9585/01** 50Ω Feedthrough Termination 1W ***$60***
**PM 9613/01** Rack Slide Kit ***$325***

### Customer Support Services

**Factory Warranty**
One-year product warranty.

## PM 5191 Specifications

### Technical Specifications

#### Frequency Characteristics

**Nominal Range:** 0.1 mHz to 2.147 MHz
**Operational Range:** Sine wave 2.147 MHz; Square wave 2.147 MHz; Triangle 200 kHz; Positive sawtooth 20 kHz; Negative sawtooth 20 kHz
**Setting:** Local via front-panel keyboard. Remote via IEEE bus interface. +/− stepping function with programmable step width
**Resolution:** 8 digits; <0.1 mHz
**Display:** 8-digit LED display, Hz/kHz indication
**Setting Error:** $<1 \times 10^{6}$
**Temperature Coefficient:** <0.2 ppm/K

## PM 5191 & PM 5193 Synthesized Function Generators

**Aging:** <1 ppm per year
**Drift:** <0.3 ppm in 7 hours
**Phase Jitter RMS:** <3 mrad
**Phase Noise:** <−80 dBc/Hz (1 kHz from carrier)

### Output Characteristics

**Main Output**
**Connector:** BNC socket on front or rear panel
**Impedance:** $Z_0 = 50\Omega$
**Load Capability:** Short-circuit proof
**Maximum External Voltage:** ±15V p-p (<3 min)

### AC Voltage

Independent of dc settings within ±15V window
**Ranges:** I 3.1 to 30V p-p open circuit;
II 0.31 to 3.00V open circuit;
III 0 to 0.300V open circuit
**Resolutions Ranges:** Range I 0.1V;
Range II 0.01V;
Range III 0.001V
**Setting:** Remote or local +/− stepping. Programmable step width.
**Basic Setting Error:** ±2.5% (1 Hz to 200 kHz) (0.31V to 3.00V)

### DC Voltage

Independent of ac setting within ±15V window
**Range:** +/− 10V open circuit voltage
**Resolution:** 0.1V
**Error:** ±2% of setting ±40 mV
**Setting:** Remote or local; +/− stepping function. Programmable step width.

### TTL Output

**Connector:** BNC socket on front panel
**Fan-Out:** 5 TTL inputs
**Level:** 0/5V

### Waveforms

**Standard Functions:** Sine wave, square wave, triangle, sawtooth (positive- and negative-going ramps)
**Selection:** Local via front panel keyboard. Remote via IEEE bus interface.
**Indication:** Key LEDs

### Sine Wave

**Frequency Range:** 0.1 mHz to 2.147 MHz
**Output Range:** 0 to 30V p-p

### Distortion

**THD:** <0.35% (1 Hz< f <200 kHz, open circuit voltage >10 mV p-p)
**Harmonics:** <−35 dBc (200 kHz< f, open circuit voltage ≥10 mV p-p)
**Spurious:** <−40 dBc (0.1 mHz< f, open circuit voltage >31 mV p-p, distance from carrier >15 kHz)

### Square Wave

**Frequency Range:** 0.1 mHz to 2.147 MHz
**Transition Times:** <35 ns
**Duty Cycle:** 50%
**Output Range:** 0 to 30 p-p
**Abberration:** <2% ±20 mV range I;
<2% ±3 mV range II

### Triangle

**Frequency Range:** 0.1 mHz to 200 kHz
**Output Range:** 0 to 30V p-p
**Temperature Coefficient:** <0.1%/K
**Linearity:** >99%

### Sawtooth (pos/neg ramps)

**Frequency Range:** 0.1 mHz to 20 kHz
**Output Range:** 0 to 15V p-p
**Temperature Coefficient:** <0.1%/K
**Flyback Time:** <1 µs
**Linearity:** >99%

### Modulation

**Internal AM**
**Carrier Frequency:** 0.1 mHz to 2 MHz
**Modulation Frequency:** 1 kHz
**Modulation Depth:** (30 ±2)%
**Modulation Distortion:** <0.6% (sine wave modulation)
**Modulation Output:** 0.3V eff ±3%
**External AM**
**Modulation Frequency:** 0 to 200 kHz
**Modulation Distortion:** <1.5% (depth <98%) <0.7% (depth <50%)

### 10 MHz Output (PM 5191S only)

**Protection:** Short-circuit proof, maximum external voltage 10V
**Frequency:** 10 MHz (square wave)
**Level:** Typical 2 dBm >0 dBm
**Impedance:** 50Ω

### External Reference Input

(PM 5191S only)
**Maximum Voltage:** ±5V
**Waveform:** Sine or square
**Frequency:** 10 MHz/N
**Lock-In Time:** <2s
**Lock-In Range:** ±0.1% – a relative frequency offset of the reference frequency, results in the same relative offset of the output frequency
**Level:** 0 to 20 dBm
**Impedance:** 50Ω

### IEEE-488 Bus Remote Control

**Control Capability:** All signal functions and characteristics
**Interface Functions:** AH1, L4, RL1, SR1, SH1, T6
**Listener Address:** Decimal programmable via keyboard, indicated by LED display
**Address Range:** 0 to 30
**Service Request:** Error message
**Remote Lock-Out:** Go-to local front panel key. Device Identification and learn modes provided as standard.

### Miscellaneous

### General Specifications

**Non-Volatile Memory:** 1 memory location for current setting
**Rear Connectors:** Modulation output BNC; Clock output BNC; Modulation input BNC; Clock input BNC; IEEE bus connector; Mains connector

### Operating Conditions

**Reference Temperature:** 23°C ±1°C
**Operating Temperature:** 5°C to 40°C
**Storage Temperature:** −20°C to +70°C

### Power Requirements

**Line Voltage:** 100V, 120V, 220V, 240V, tolerance ±10%
**Line Frequency:** 50 Hz to 60 Hz, tolerance ±5%
**Power Consumption:** 100W

### Mechanical Data

**Size:** 105 mm H × 440 mm W × 430 mm L (4.1 in H × 17.3 in W × 16.9 in L), rack mounting facility standard (2 units high)
**Weight:** 10 kg (22 lb)

## Ordering Information

### Models

### U.S. Versions

**PM 5191M** Programmable Synthesizer/ Function Generator ***$4330***
**PM 5191SM** Programmable Synthesizer/ Function Generator with 10 MHz Reference Input ***$4540***

### European Versions

**PM 5191** Programmable Synthesizer/ Function Generator ***$4330***
**PM 5191S** Programmable Synthesizer/ Function Generator with 10 MHz Reference Input ***$4540***

**Included with Instrument**
One-year product warranty, line cord, rack mounting brackets, programming card, Operator's manual and Certificate of Calibration Practices.

### Option

**Rear Panel Output**

### Accessories

**PM 9051** BNC to 4 mm Banana Adapter ***$27***
**PM 9551** 50Ω to 600Ω Adapter ***$105***
**PM 9581/01** 50Ω Feedthrough Termination 3W ***$100***
**PM 9585/01** 50Ω Feedthrough Termination 1W ***$60***
**PM 9613/01** Rack Slide Kit ***$325***

### Manuals

**No charge with purchase of unit*

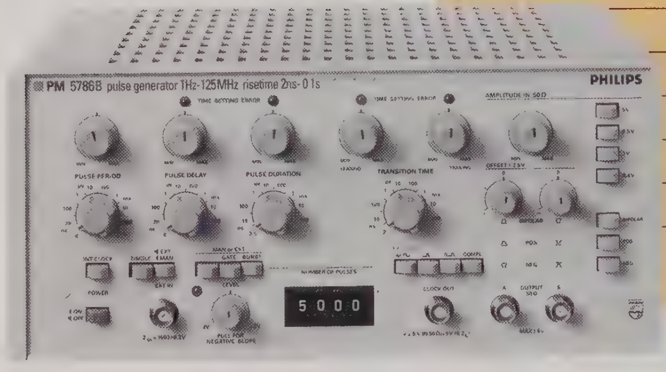
### Customer Support Services

**Factory Warranty**
One-year product warranty.

# Pulse Generators

## PM 5786 125 MHz Pulse Generator

- 1 Hz to 125 MHz pulse frequencies
- 2 ns to 100 ms rise and fall times
- Time-setting error LED indicators
- 0.2V to 5V amplitude into 50Ω
- Dual outputs for simultaneous + and – pulses
- Full external control facilities
- LED indicator for correct trigger levels
- Presettable burst option



PM 5786B

## Specifications

### Technical Specifications

#### Time Parameters

**Pulse Repetition Period:** 8 ns to 1s (1 Hz to 125 MHz)
**Pulse Delay:** 8 ns to 100 ms
**Pulse Duration:** 3.5 ns to 100 ms or fixed square wave
**Jitter:** <0.1% of setting ±50 ps

#### Main Output Pulse Characteristics

**Outputs:** 2 channels, A and B
**Transition Times:** At $Z_L$ = 50Ω, 2 ns to >100 ms, continuously variable, corresponding to 10% to 90% of pulse amplitude
**Pulse Amplitude:** 0.2V to 5V (at $Z_L$ = 50Ω), double amplitude at open output
**DC Offset:** –2.5V to +2.5V (at $Z_L$ = 50Ω), ±5V at open output
**Max. Output Voltage:** Pulse amplitude plus dc offset is ±6V at max. Maximum 10V open output voltage within the –6v to +6V range.
**Waveform Aberrations:** $Z_L$ = 50Ω, <5% ±10 mV, <10% for transition times <5 ns
**Source Resistance:** 50Ω ±5%
**Source Impedance:** 50Ω ±10%
**Output Protection:** Against short- or open-circuit and transients

#### Pulse Modes

- Single pulse (delayable)
- Double pulse
- Square wave:
  50% ± 1% (1 Hz to 1 MHz);
  50% ±10% (1 MHz to 125 MHz)
- Normal or complementary switchable

**Output Modes:** Bipolar, positive, negative polarity

#### External Operating Modes

**TRIGG:** Ext. triggered pulse repetition: DC to 125 MHz or manual single shot
**GATE:** Synchronous gating. Ext. input signal starts and stops the generator
**BURST:** Internally generated burst with digital switch selection of number of pulses: 0 to 9999, started by ext. input signal or manual control
**EXT DUR:** External duration gives pulses with same duration and repetition rate as external input signal, all other pulse parameters are set via the generator

#### External Input

**Range:** DC to 125 MHz; min. pulse duration 3.5 ns
**Operating Input Voltage Range:** 0.5 to 15V p-p
**Coupling:** DC
**Input Impedance:** 1 MΩ//25 pF
**Trigger Level:** –3V to +3V
**Trigger Slope:** + and –
**Trigger Indicator:** Tri-state LED indicator for correct trigger level setting
**Maximum Input Voltage Without Damage:** 260V rms at ≤440 Hz, declining to 15V p-p at 125 MHz

#### Internal Clock Output

Main output pulse is delayable with respect to internal clock output, which can thus be used as pre-trigger
**Amplitude:** +2.5V into 50Ω
**Output Impedance:** 50Ω (typ)
**Transition Time:** Approximately 1 ns
**Pulse Duration:** Square wave, 50% ±1% (1 Hz to 1 MHz), 50% ±10% (1 to 125 MHz)
**Output Protection:** Against short- or open-circuit and transients

#### Power Requirements

**Line:** 100V, 120V, 220V and 240V ±10%;

### General Specifications

120 VA, 50 to 60 Hz
**Safety:** According to IEC 348 and CSA 556B
**Line Interference:** Below VDE 0871 (B)

#### Environmental Data

**Temperature**
**Rated Range of Use:** 0°C to +50°C
**Storage and Transport:** –40°C to +70°C
**Humidity**
**Operating:** 10 to 90% RH, no condensation
**Storage:** 5 to 95% RH

#### Mechanical Data

**Size:** 300 mm W × 145 mm H × 470 mm L (11.8 in W × 5.7 in H × 18.5 in L)
**Weight:** 9.5 kg (21 lbs)

## Ordering Information

#### Models

**PM 5786/00** 2 ns Pulse Generator; excluding preset burst unit ***$5140***
**PM 5786B/00** 2 ns Pulse Generator; including preset burst unit ***$5890***

#### Included with Instrument

One-year product warranty, line cord, operator and service manual, and Certificate of Calibration Practices.

#### Accessories

**PM 9581/01** 50Ω Feedthrough Termination; 3W ***$100***
**PM 9584/02** 50Ω T-piece matched power-splitter ***$95***
**PM 9585/01** 50Ω Feedthrough Termination 1W ***$60***
**PM 9588/01** 50Ω Coaxial Cable Set (5 × 1 ns, 4 × 2 ns, 3 × 3 ns, 3 × 10 ns) ***$375***

### Customer Support Services

#### Factory Warranty

One-year product warranty.

# Pulse Generators

## PM 5712 & PM 5715 50 MHz Pulse Generators

PM 5712

PM 5715

Frequency range: 1 Hz to 50 MHz

Rise/fall times: PM 5712, 4 ns fixed; PM 5715, 6 ns to 500 ms, variable

Amplitude range: 0.2V to 10V

DC offset: PM 5712, −5V to +2V; PM 5715, −2.5V to +2.5V

Facilities for: manual and external triggering, gating, and pulse shaping

Pulse modes: single/double,

## Specifications

### Technical Specifications

#### Time Parameters

**Pulse Repetition Time:** 20 ns to 1s (1 Hz to 50 MHz)
**Pulse Delay:** 10 ns to 100 ms
**Pulse Duration:** 10 ns to 100 ms
**Jitter:** ≤0.1% of setting ±50 ps

#### Main Output Pulse Characteristics

**Pulse Amplitude:** 0.2V to 10V at $Z_L$ = 50Ω
**Polarity**
**PM 5715:** + or - switchable
**PM 5712:** + only, pulses within −5V to +10V possible, using dc offset and norm/inv
**Transition Times**
**PM 5715:** 6 ns to 500 ms
**PM 5712:** 4 ns fixed
**DC Offset at $Z_L$ = 50Ω**
**PM 5715:** −2.5V to +2.5V
**PM 5712:** −5V to +2V
**Max Output Voltage:** Pulse amplitude and dc offset max. +10V
**Waveform Aberrations:** <±5% of set amplitude
**Source Impedance:** Current source of 200 mA in 10V range, terminated with internal 50Ω in 5V and lower ranges
**Pulse Modes**

- Single pulse (delayable)
- Double pulse
- T/2, 50% duty cycle, 50 ±20% duty cycle in 20 ns and 100 ns repetition range

**Logic Mode:** Normal or inverted

#### Auxiliary Pulse Output Characteristics

**Pulse Amplitude:** TTL-compatible, +2.5V into 50Ω or +4.5V open circuit
**Source Impedance:** 50Ω
**Pulse Modes:** Single pulse, double pulse, not T/2. The pulse occurs approx. 12 ns ahead of main pulse.
**Output Protection:** Against short or open circuit

#### Sync. Output

**Function:** Pre-trigger output, main output pulse is delayable with respect to sync. output
**Amplitude:** +1.5V at $Z_L$ = 50Ω, +3V open circuit
**Output Impedance:** 50Ω
**Pulse Duration:** Square wave
**Output Protection:** Against short or open circuit

#### External Operating Modes

**TRIG:** Ext. triggered pulses, range: DC to 50 MHz or manual single shot
**GATE:** Synchronous gating, external signal starts and stops the generator
**EXT DUR:** External duration gives pulses with same duration and repetition rate as external input signal, all other pulse parameters are set via the generator

#### External Input

**Function:** For external trigger, gate and duration
**Range:** DC to 50 MHz
**Coupling:** DC
**Input Impedance:** Approx 220Ω at <1.5V, approx 800Ω at >1.5V
**Trigger Level:** ≥+1V
**Trigger Slope:** Positive
**Max. Input Voltage Without Damage:** ±12V

### General Specifications

#### Power Requirements

**Line:** 85V to 110V, 99V to 127V; 170V to 220V, 198V to 255V
**Line Frequency:** 50 Hz to 400 Hz
**Power Consumption:** 70 VA

#### Environmental Data

**Temperature Range**
**Operating:** 0°C to 50°C
**Storage:** −40°C to 70°C

#### Mechanical Data

**Size:** 210 mm W × 130 mm H × 275 mm L (8.3 in W × 5 in H × 10.8 in L)
**Weight:** 4 kg (8.8 lb)

## Ordering Information

### Models

**PM 5712/08** Pulse Generator ***$2390***
**PM 5715/11** Pulse Generator ***$2690***

### Included with Instrument

One-year product warranty, line cord, and operator manual.

### Accessories

**PM 9581/01** 50Ω Feedthrough Termination 3W ***$100***
**PM 9584/02** 50Ω T-piece matched power-splitter ***$95***
**PM 9585/01** 50Ω Feedthrough Termination 1W ***$60***
**PM 9588/01** 50Ω Coaxial Cable Set ***$375***

### Manuals

**PM 5712** Service
**PM 5712-15** Operator*
**PM 5715** Service
*No charge with purchase of unit

### Customer Support Services

#### Factory Warranty

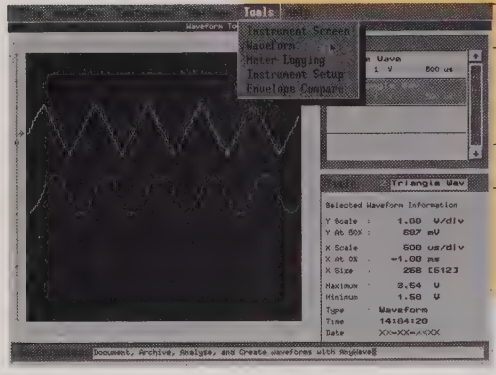
One-year product warranty.

FLUKE

# Software

## PM 2273 AnyWave™ Software for DOS

- Capture and store screens, images or waveforms
- Filter, smooth, add, subtract and multiply waveforms
- Sketch waveforms free hand or point to point
- Interactive control of ScopeMeter or CombiScope attenuation, timebase, coupling, meter functions and triggering
- On line context sensitive help always available
- Modem communication support



Selected Waveform Information
Y Scale : 1.00 V/div
Y At 50% : 587 mV
X Scale 500 us/div
X At 0% -1.00 ms
X Size 288 [512]
Maximum 3.54 V
Minimum 1.50 V
Type Waveform
Time 14:04:20
Date XX-XX-XXXX

Document, Archive, Analyse, and Create waveforms with AnyWave

PM 2273

### Add PC Power to your ScopeMeter®, CombiScope™ or Arbitrary Waveform Generator

AnyWave Software documents measurements the easy way. A simple way to manage and process your measurement data and results, with an intuitive mouse driven graphic user interface.

### Document

Capture waveforms and measurement data on the PC. Print out complete instrument screens directly, or store graphical data in a popular file format and import into your favorite word processor or spreadsheet.

### Archive

Waveform storage and retrieval with text annotations like measurement conditions and instrument set-ups. Ideal for creating your own library of waveforms, screen images and setups for reference and comparison purposes. Database management functions allow files to be saved and retrieved with keywords.

### Analyze

Get valuable extra measurement data, reveal relationships and conditions that could otherwise remain hidden. You can also log ScopeMeter meter reading to monitor and analyze slowly changing signals and related events.

### Waveform creation for Fluke Arbitrary Waveform Generators

Create and edit waveforms and signal envelopes quickly and conveniently. Starting from scratch, waveforms can simply be drawn or edited on your PC screen with the mouse, using a selection of freehand and linedraw modes and drawing tools. Use real-life waveforms captured from your CombiScope or ScopeMeter test tool, then edit as required to meet specific test needs. The zoom facility offers increased resolution when dealing with small parts of a waveform, for detailed viewing and editing.

Extended waveform sequences can be created by using test sequence option. The sequences can be transferred to a Fluke arbitrary waveform generator with optional sequence generator.

### Test Envelope Creation

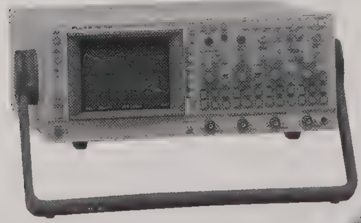
Easy creation of test envelopes (or templates) defined by upper and lower limit waveforms. These envelopes serve as a reference for other waveforms captured by your CombiScope or ScopeMeter test tool, enabling instant, automatic pass/fail testing. A clear pass/fail indication is given on-screen, and failing waveforms can be transferred automatically to the PC for analysis or archiving. Test envelopes can be created simply by editing captured signals or by freehand drawing.

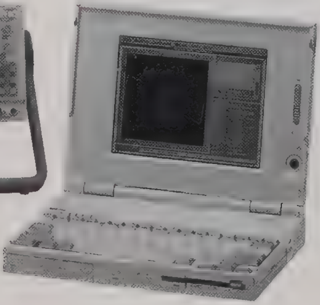
### Supported Instruments

ScopeMeter: 97, 99, 105 (RS 232)
ScopeMeter: 91, 92, 96 Screen Capture only (RS-232)
4 channel CombiScope: PM 3382, PM 3384, PM 3392, PM 3394, (GPIB & RS-232), PM 3384 (RS-232)
Autoranging 4 channel: CombiScope PM 3382A, PM 3384A, PM 3392A, PM 3394A, (GPIB & RS-232)
Autoranging 2 channel: CombiScope PM 3370A, PM 3380A, PM 3390A, (GPIB & RS-232)
2 channel CombiScope: PM 3331/80 (RS-232), PM 3335, PM 3350, PM 3350A, PM 3355, PM 3365, PM 3365A, PM 3375, (GPIB & RS-232)
Arbitrary waveform generator: PM 5138, PM 5138A, PM 5139, PM 5150 (GPIB & RS-232)

### System Requirements

IBM PC/AT or compatible
EGA or VGA graphics adapter
MSDOS® 3.3 or later, Min. 450 KB free memory
Microsoft® Mouse or compatible
Supports over 100 printers
One free RS-232 port or GPIB interface
PM 2201/03





## Ordering Information

### Models

**PM 2273/002** AnyWave 2.0 for DOS ***$295***

**PM 2273/502** AnyWave 2.0 for DOS upgrade version (for AnyWave 1.0 or 1.1) ***$125***

**PM 2273/902** AnyWave 2.0 for DOS multicopy version ***$175***

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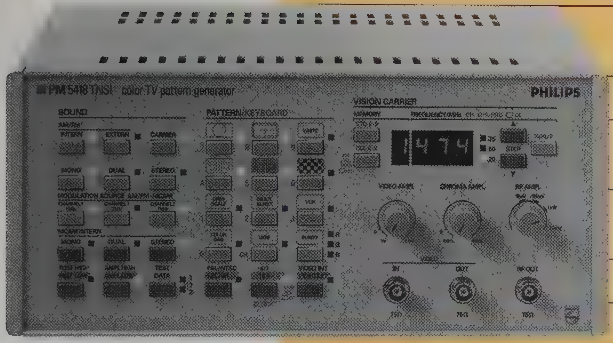
AnyWave, CombiScope and FlukeView are trademarks, and ScopeMeter is a registered trademark of Fluke Corp.

# TV Test Tools

## PM 5400 family of TV Signal Generators

**New!** PALplus Test Capability

Over 100 video test patterns for PAL, NTSC and SECAM video standards



Digitally generated patterns for high-precision geometry alignment

16:9 and 4:3 aspect ratio patterns

Special patterns for VCR and 100 Hz IDTV (Improved Definition TV) testing

Mono, stereo, NICAM and MTS Stereo plus SAP (BTSC) sound test signals

Teletext TOP/FLOF, VPT and Antiope test signals

Easily programmable PDC (Program Delivery Control) and VPS test signals

Closed Caption test signals

Full RF coverage from 32 to 900 MHz with int./ext. modulation

RGB, Y/C (S-VHS/Hi-8), CVBS and audio outputs

IEEE-488 programmable

### Model Selection Guide

| Main Model | PAL | NEW! PALPlus | NTSC | SECAM | Video Out | RF Out | 16:9 | Y/C + RGB | Mono Sound | Analog Stereo | NICAM Stereo | MTS Stereo + SAP | Teletext TOP/ FLOF Antiope | PDC/ VPS | CC | IEEE |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| PM 5414 | ● | | ● | | ● | | | opt | | | | | | | | |
| PM 5415 | ● | | ● | | ● | ● | ● | opt | ● | opt | opt | opt | opt | opt | opt | |
| PM 5418 | ● | | ● | ● | ● | ● | ● | opt | ● | opt | opt | opt | opt | opt | opt | opt |
| PM 5420 | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● | ● |

### All the Signals You Need for TV, VCR and Monitor Testing

The PM 5400 family from Fluke offers today's widest choice of TV and video test signals from a range of compact instruments. These state of the art generators provide support for TV, VCR and video monitor testing in all the PAL, NTSC and SECAM standards. Their basic functionality includes test patterns and outputs to test and align the total signal paths for video, audio and data services such as Teletext and Closed Caption. Signals are provided for testing overall picture geometry for both 4:3 and wide screen 16:9 aspect ratios, as well as specific parameters such as high-voltage stability, beam current, static and dynamic convergence, picture resolution, color purity and color reproduction, and all vision and sound demodulators. Special test patterns and formats for VCR's, 100 Hz TV, and now PALplus make these today's most versatile generators for the world's latest and most demanding test applications.

The multistandard, multifunction capability of these instruments, together with the wide range of options, means that there is always a model to match any set of requirements, whether it is in R&D, manufacturing, quality assurance, installation, service or training. The uniquely versatile PM 5400's meet a complete set of test requirements with a single, compact instrument. They are especially well suited for maintenance work by central service workshops that need to have access to all TV and VCR functions. IEEE-488 GPIB-programmable options make these models perfect for automated production-line testing.

### RF Selection

All models with RF output cover the entire frequency range from 32 to 900 MHz, including IF and all TV transmission bands, as well as all S- and hyperband cable TV channels. Selection of the synthesized RF frequency within these bands is done electronically via the keyboard. The step function enables fine adjustment and RF tuning. The RF carrier can also be switched off at intervals of approximately 10 seconds to test the synchronization circuitry.

### Memory

Up to ten front panel settings for different test situations can be stored in memory for later recall. In this set-up data, the channel selection can be defined as frequency in MHz or as channel number.

### Teletext

The PM 5400 family has specific functions to meet the highly specialized requirements of checking and aligning teletext receivers and decoders. They offer a selection of over ten teletext pages with special contents for decoder testing. The DIDON ANTIOPE teletext signal is also available as standard. Selection of DIDON ANTIOPE or UK Teletext is by a rear-panel switch.

### FLOF, TOP and VPT

The test facilities of the PM 5400 family has been extended by a selection of teletext pages including normal teletext, FLOF (Full Level One Features), TOP (Table Of Pages) and VPT (Video Programming by Teletext). FLOF is used in the UK, while TOP is used in Germany, Switzerland and Austria, as well as via cable distribution systems in the Netherlands. VPT is a system which provides a menu that makes home VCR programming simple.

### Y/C + RGB Option (PM 9553G)

The Y/C + RGB module provides the separate luminance and chroma (Y/C) outputs needed by new-generation S-VHS/Hi-8 video recorders and Y/C monitors. The PM 9553G Y/C + RGB module can be retrofitted to the PM 5414 V, PM 5415 and PM 5418 TV signal generators, and is standard in the PM 5420.

### NICAM Digital Sound

NICAM digital sound provides two high-quality digital sound channels and is compatible with existing PAL types B, G and I terrestrial TV and cable TV standards. NICAM is now also available in SECAM L. Suitable TV sets can receive two mono channels for simultaneous translation of foreign-language programs, stereo signals or transparent transmission of data.

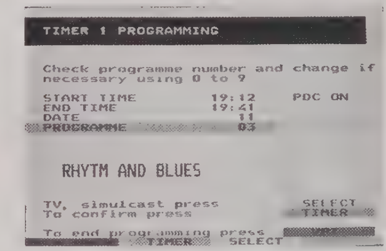
The PM 5400 family provides the ability to select more than 55 digital sound test signals instantly, at any time, thereby speeding and simplifying operation. The generators provide two digital sound channels with selectable low- or high-amplitude signals to test the expander of the TV receiver. Standard 1 kHz tones check the sound channels, and a 3 kHz tone on channel 1 can test the stereo or dual-sound performance of the TV. Three special test signals (Data 1, 2 and 3) are available to check the operation of the demodulator and decoder. An RSSF (Reserve Sound Switching Flag) is high/low selectable to indicate that the analog and digital sound carriers are transmitting different information, or to indicate faults in the digital transmission.

### MTS Stereo and SAP (BTSC Sound)

In accordance with the BTSC standard, Multi-channel Television Sound (MTS), is available in combination with NTSC M and PAL M TV standards. In addition to mono and stereo sound, a Second Audio Program (SAP) is also available. Three test modes and special test signals are useful for easy functional testing of the stereo and SAP decoder. The sound signals are digitally generated which ensures high stability, and they are available at the RF output or via baseband processing at the precision MPX output.

### PDC/VPS Test Facilities

PDC and VPS systems use control information transmitted by the broadcaster to synchronize recording on a VCR with a transmitted program. Complete testing of video cassette recorders equipped with PDC / VPS under the PAL B, G, H, I, D and N standards is possible with the PM 5400 family. With PDC, the PIL (date & time), CNI (country & network), PTY and PTL are programmable. Special signals such as timer control code, recording inhibit/terminate code, interruption code and continuation code can also be selected. In VPS mode, parameters such as date, transmission time, country indication, TV channel, stereo/dual/mono sound and adult/general are included. Special signals such as LEER code, program interrupt and system status can also be selected. PDC / VPS data is shown in a 1/6 screen height horizontal bar which can be combined with any test pattern and displayed in six positions, either on- or off-screen.



```
TIMER 1 PROGRAMMING

Check programme number and change if
necessary using 0 to 9

START TIME              19:12    PDC ON
END TIME                19:41
DATE                       11
PROGRAMME                  03


   RHYTM AND BLUES

TV, simulcast press              SELECT
To confirm press                 TIMER

To end programming press
            TIMER     SELECT
```

### Closed Caption

Closed Caption provides a textual depiction of information simultaneously being provided on the audio portion of a television signal. TV receivers with a screen size of 13" (or larger) sold in the USA after July 1993 must have a Closed Caption decoder.

The PM 5400 family offers both Caption and Text modes in either of two operating channels. The Closed Caption information is present in line 21 of the video signal. Factory-coded Closed Caption information with a selection of 8 different display modes is possible. Additionally, selecting mode 9 provides a continuous automatic progression of modes 1 through 8, so all display methods can easily be tested.

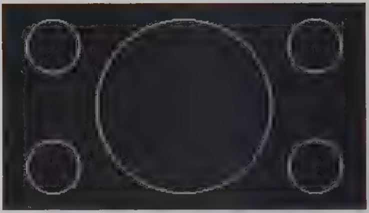
### GPIB/IEEE-488

For use in systems applications, the PM 5418 TXI, PM 5418 TSDI and PM 5420 are configured with an IEEE-488 interface. All the available TV and sound modulation standards can be selected remotely, and "bus learn mode" and "identification mode" are included.

## Every Test Pattern You Need, at the Touch of a Button

### Circle.

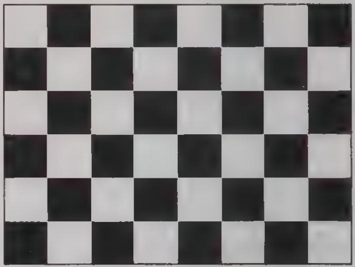
The white circle on black background is used for checking overall linearity and geometry. The white circle changes automatically to black when used with the white pattern and is useful for checking reflections. In 16:9 Aspect Ratio format, small circles are placed in the corners of the screen.



16:9 test pattern

### Checkerboard.

A pattern of six by eight (4:3) or six by eleven (16:9) columns of squares which provides a visual standard for basic picture tube alignments such as centering, focus, horizontal and vertical deflection, and linearity.



4:3 checkerboard test pattern

### Center Cross/Border Castellations.

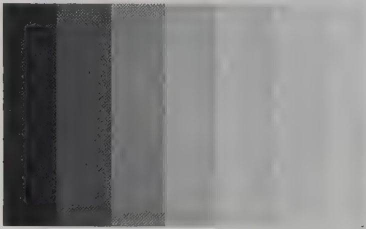
Used for centering TV monitors and TV screens, for checking the deflection linearity and for pincushion correction.

### 100% White with Swinging Burst.

Designed for setting white D and for an overall check of purity. It is also used for beam current adjustment. White D is the correct white necessary for natural color reproduction.

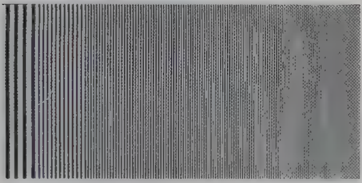
### Gray Scale.

Full-screen linear staircase signal with 8 equal steps from black to white used to locate non-linearity in the video amplifier or gray-scale setting.

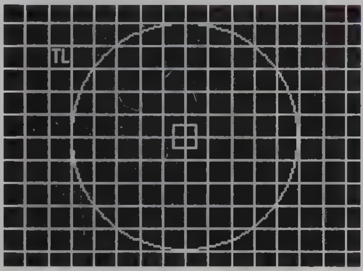


# PM 5400 family of TV Signal Generators

**Multiburst.**
Eight full-screen vertical bars of definition lines in the frequency ranges 0.8, 1.8, 2.8, 3.0, 3.2, 3.4, 3.8 and 4.8 MHz. Used to check the bandwidth of the video or luminance amplifier in black and white or color TV as well as the resolution of monitors and video recorders.



**Cross Hatch.**
Either 17 (4:3 image) or 21 (16:9 image) vertical and 11 horizontal lines are used for checking and re-aligning dynamic and corner convergence. Both patterns include center box and Top-Left Indication (TL). The pattern has no interlacing to provide the best image stability and reduce eye strain. If interlacing is desired it is achieved by superimposing another pattern such as center cross, circle or dots.

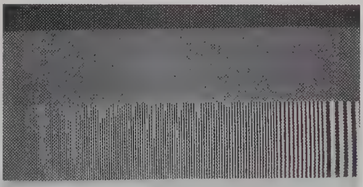


4:3 test pattern on a 4:3 TV set

**Dot Pattern.**
Full screen grid of white dots used to test static convergence. Convergence problems in the receiver will cause the dots to appear some color besides white.

**VCR.**
A specially-designed test pattern to check the bandwidth, linearity, sensitivity and AGC of the chroma amplifiers in color video recorders. This combined test pattern is divided into 4 horizontal segments:

- 24 lines of 100% white level.
- Eight bars of resolution of which 2.8 - 3.0 - 3.2 - 3.4 MHz are used to align the high-pass filter for a maximum resolution in VCR bandwidth.
- Eight steps of decreasing linear levels of saturation from 100 to 0% to check the chroma amplifier linearity and color AGC circuitry.
- A black horizontal bar with a moving white field to check moving pictures on video recorders.



**Purity.**
A choice of the three primary colors is clearly indicated by LEDs. The red pattern is used for checking color purity. The green pattern provides a purity check for three-in-line tubes. Blue is also available to check color performance. The three complementary colors magenta, yellow and cyan can also be displayed by selection, as can white and black. Combinations with circle and/or center cross are easy to select.

**Color Bar.**
Standard 8 segment vertical color bar. The bars are white D, yellow, cyan, green, magenta, red, blue and black. The color bar pattern provides sufficient information for a good overall check of color performance, including checks on burst keying, subcarrier regeneration, RGB amplifiers, the delay color versus B/W signal and saturation.

**DEM Pattern.**
A combined demodulator test pattern. Divided into 4 sections, it contains information to make on-screen checks and alignments of the color demodulators and subcarrier frequency. For PAL it is used to check the chroma delay line for amplitude and phase (venetian blinds). For the NTSC system, the pattern meets NTSC requirements. The pattern contains 7 color bars, -I and +Q signals, and a black and white reference field.

**Test Pattern Combinations.**
Over 100 test pattern combinations can be selected to meet special requirements.

## PALplus - PM 5420

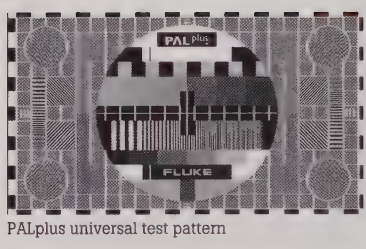
The PM 5420 contains a set of specially-designed signals and patterns for testing and production of PALplus receivers. PALplus TV receivers must have the capability to decode standard PAL signals as well. Therefore all patterns (including 4:3 and 16:9 aspect ratio tests) which are provided in the PM 5400 family are also included in the PM 5420.

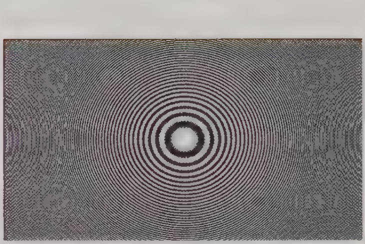
**Film Mode and Camera Mode.** The PALplus standard defines two different modes of operation: film mode and camera mode. Both modes are supported with the PM 5420. In film mode, two fields of information which are scanned from the same image are projected. As a result, no detectable motion is present between the two fields and motion detecting functions in the TV receiver are therefore disabled. In camera mode, motion is present in the image and the receiver's motion processing circuitry will be active. This dual mode support by the PM 5420 allows more accurate isolation of faults within the receiver's motion detection and adaptive circuitry.

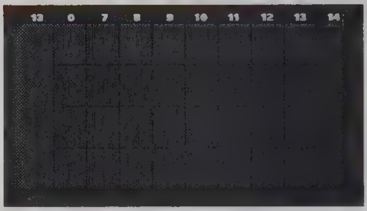
**The PALplus Universal 16:9** test pattern in film or camera mode is used for several applications. It contains crosshatch, corner circles with resolution wedges, horizontal and vertical overscan marks, resolution lines and decoder signals. It is used for alignment or checking RF reflection, frequency response, bandwidth, geometry (deflection and linearity), synchronization, focusing, static and dynamic convergence, color decoding or RGB setting. In addition there is a special DEC in film or camera mode indication (patent pending) which displays the use of the helper lines.

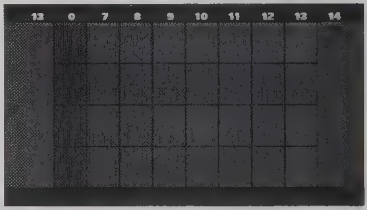
**Zoneplate.** Used to check ColorPlus functions and the operation of the PALplus "helper" lines. The zoneplate provides a frequency sweep signal with luminance changes in vertical and horizontal direction. The pattern will show no color when ColorPlus is active. Color, as a result of cross-color effects, will be visible on screen when the ColorPlus circuit is defect or not working properly. The helper lines contain information about the luminance

## PM 5400 family of TV Signal Generators


PALplus universal test pattern


Zoneplate pattern


16:9, Frame 1 MACP test pattern


MACP test pattern, frame 2.

differences between several lines. When the helper lines are used correctly, the receiver provides its maximum bandwidth.

**MACP Pattern (patent pending).** Used for checking Motion Adaptive ColorPlus (MACP) functions of the TV receiver. The MACP pattern provides a 3.8 MHz luminance signal with changing color saturation between successive frames. The color saturation changes are interpreted by the receiver as motion, and the resulting motion sweep is used to check whether MACP is working properly. The MACP system in the TV receiver will automatically attenuate the luminance signal above 3 MHz. The intraframe averaging of the color can be checked with this pattern (test 2) as well.

In addition, the PM 5420 from Fluke offers a MACP pattern (test 1) that provides attenuated luminance and averaged chroma signals according to the PALplus standard. This pattern can be used to check how a PALplus TV receiver behaves when receiving a standard PAL signal.

### TV Signal Generator Ordering Guide

| Main models | Models | General | | | | PAL | | | | | | | NTSC | | | SECAM | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | RF | 16:9 | IEEE | Y/C+ RGB (PM 9553G) | system B D G H I | system M N (PM 9546) | PAL-plus system B D G H I) | Analog stereo sound (system B G) | NICAM stereo (system B G I) | Teletext TOP/ FLOF Antiope (system B D G H I N) | PDC/ VPS (system B D G H I N) | system M M:4.43 | MTS stereo + SAP sound (system M) | CC (system M) | system B D G H K K1 L | NICAM stereo (system L) | Teletext Antiope TOP/ FLOF (system B D G H K K1 L) |
| PM 5414 | PM 5414 V | | | | | • | opt | | | | | | • | | | | | |
| | PM 5414 V+Y/C | | | | • | • | opt | | | | | | • | | | | | |
| PM 5415 | PM 5415 | • | • | | | • | opt | | | | | | • | | | | | |
| | PM 5415+Y/C | • | • | | • | • | opt | | | | | | • | | | | | |
| | PM 5415 BC* | • | • | | | • | opt | | | | | | • | • | • | | | |
| | PM 5415 BC+Y/C* | • | | | • | opt | | | | | | • | • | • | | | | |
| | PM 5415 TX | • | • | | | • | opt | | • | | • | | • | | | | | |
| | PM 5415 TX+Y/C | • | • | | • | • | opt | | • | | • | | • | | | | | |
| | PM 5415 TXS | • | • | | | • | opt | | • | | • | • | • | | • | | | |
| | PM 5415 TXS+Y/C | • | • | | • | • | opt | | • | | • | • | • | | • | | | |
| | PM 5415 TN | • | • | | | • | opt | | • | • | • | | • | | | | | |
| | PM 5415 TN+Y/C | • | • | | • | • | opt | | • | • | • | | • | | | | | |
| | PM 5415 TNS | • | • | | | • | opt | | • | • | • | • | • | | • | | | |
| | PM 5415 TNS+Y/C | • | • | | • | • | opt | | • | • | • | • | • | | • | | | |
| PM 5418 | PM 5418 | • | • | | | • | opt | | | | | | • | | | • | | |
| | PM 5418+Y/C | • | • | | • | • | opt | | | | | | • | | | • | | |
| | PM 5418 TX | • | • | | | • | opt | | • | | • | | • | | | • | | • |
| | PM 5418 TX+Y/C | • | • | | • | • | opt | | • | | • | | • | | | • | | • |
| | PM 5418 TXS | • | • | | | • | opt | | • | | • | • | • | | • | • | | • |
| | PM 5418 TXS+Y/C | • | • | | • | • | opt | | • | | • | • | • | | • | • | | • |
| | PM 5418 TD | • | • | | | • | opt | | • | • | • | | • | • | | • | • | • |
| | PM 5418 TD+Y/C | • | • | | • | • | opt | | • | • | • | | • | • | | • | • | • |
| | PM 5418 TDS | • | • | | | • | opt | | • | • | • | • | • | • | • | • | • | • |
| | PM 5418 TDS+Y/C | • | • | | • | • | opt | | • | • | • | • | • | • | • | • | • | • |
| | PM 5418 TXI+Y/C | • | • | • | • | • | • | | • | | • | | • | | | • | | • |
| | PM 5418 TDSI+Y/C | • | • | • | • | • | • | | • | • | • | • | • | • | • | • | • | • |
| PM 5420 | PM 5420 | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • | • |

* not available in Europe

opt = Optional available
PM 9546: Universal chroma unit (PAL M N systems), standard present in PM 5418 TXI+Y/C and PM 5418 TDSI+Y/C, and PM 5420
PM 9553 G: Y/C + RGB output, standard present in +Y/C instruments (e.g. PM 5414 V+Y/C, PM 5415 TXS+Y/C or PM 5418+Y/C), and PM 5420
PM 9561G: 19" Rackmount

## PM 5400 family of TV Signal Generators

| Main models | Description |
|---|---|
| PM 5414 | PAL / NTSC Video pattern generator (video only) |
| PM 5415 | PAL / NTSC TV-signal generator, inclusive: 16:9 aspect ratio, sound and RF-output |
| PM 5418 | PAL / NTSC / SECAM TV-signal generator, inclusive: 16:9 aspect ratio, sound and RF-output |
| PM 5420 | PAL / PALplus / NTSC / SECAM TV-signal generator, inclusive: 16:9 aspect ratio, stereo sound, RF-output, teletext and Y/C |

| Versions | Description |
|---|---|
| BC | MTS Stereo plus SAP (BTSC) and Closed Caption |
| T or TX | Analog stereo and Teletext (TOP/FLOF and Antiope) |
| N | NICAM digital sound |
| S | PDC / VPS and Closed Caption |
| D | MTS Stereo plus SAP (BTSC) and NICAM digital sound |
| I | IEEE/GPIB interface |

## Specifications

### Technical Specifications

The technical specifications shown below are valid in a temperature range from +5°C to +50°C. Specifications apply with outputs terminated with 75Ω. Stated tolerances apply after a warm-up time of 30 minutes and a recalibration interval of 12 months.

### Video Carrier PM 5415, PM 5418, PM 5420

**Frequency Range:** 32 to 900 MHz, without interruption, covering VHF, UHF, S- and Hyperbands
**Frequency Selection:** Keyboard
**Fine Tuning:** ±250 kHz steps for TV frequencies, ±100 kHz steps for IF frequencies (32 to 44.9 MHz)
**Frequency Tuning:** Tuning speed increase by holding step button
**Storage:** a) Possibility for 10 different RF frequencies
b) As a), indicated as TV channel numbers
**Indication:** 4-digit 7-segment LED display
a) First digit: memory, store and recall position 0 to 9
b) Digits 2-4 plus separate LEDs for frequency indication with 250 kHz display resolution.
c) Keyboard-selectable TV channel numbers (e.g. C21 or C70)

### RF Output

**RF Output:** BNC connector (front panel)
**Impedance:** 75Ω
**Output Voltage:** 10 mV ± 2 mV
**Attenuation:** 60 dB, continuous
**Group Delay Pre-Correction (PM 5420 only):** For TV standards B, G, H, N and M

### Video Modulation

**Modulation:** AM internal-external switchable
**Polarity:** Negative/positive for SECAM L

### Video Input

**Video Input:** BNC connector (front panel)
**Input Voltage (Vpp):** 1V
**Max. Permissible Input Voltage:** ± 5V
**Impedance:** 75Ω
**Polarity:** White level positive
**Coupling:** DC (clamping on sync.)

### Video PM 5414 V, PM 5415, PM 5418, PM 5420

### Video Outputs

**Video Output:**
a) BNC connector
b) SCART connector (Euro-AV connector), pin 19 (rear)
**Impedance:** 75Ω
**Voltage (Vpp):**
a) 1V fixed
b) Continuously variable between 0 to 1.5V/75Ω
**Polarity:** White level positive
**Coupling:** DC

### Synchronization

**Line Frequency:** 15,734 Hz (RTMA), 15, 625 Hz (CCIR)
**Frequency Tolerance:** 0.4 Hz
**Number of Lines:** 525 (RTMA), 625 (CCIR)
**Field Frequency:** 60 Hz (RTMA), 50 Hz (CCIR)
**Line and Frame Sync.:** According to TV standard

### Trigger

**Output:** BNC connector
**Trigger Signal:** Combined signal at line and field synchronization pulses with amplitude difference
**Voltage (Open Circuit):** 2.6V for line pulse, 5.0V for field pulse
**Impedance:** 6 kΩ
**Polarity:** Negative

### CHROMA PM 5414 V, PM 5415, PM 5418, PM 5420 CHROMA NTSC/PAL

**Chroma Standards:** NTSC M;
PAL B, D, G, H, I;
PAL M, N for PM 5418 TXI, PM 5418 TDSI, PM 5420, instruments incl. option PM 9553G
**Selection:** Rear panel thumbwheel switch
**Subcarrier Frequency:** 3.579545 MHz for NTSC M;
4.433619 MHz for NTSC M4.43;
4.433619 MHz for PAL B, D, G, H, I;
3.575611 MHz for PAL M;
3.582056 MHz for PAL N
**Tolerance:** 30 p.p.m.
3 p.p.m. for PM 5415 TN(S), PM 5418 TXI, PM 5418 TD(S)(I), PM 5420
**Burst:** Position, number of cycles and phase according to selected standard
**Amplitude:** Chroma with burst
A) Fixed (100%)
b) Continuously variable from 0 to 150%
**Chroma Vectors Inaccuracy:** Phase ≤ 3°, amplitude ≤ 5% relative to luminance amplitude

### CHROMA SECAM PM 5418, PM 5420

**Chroma Standards:** SECAM B, D, G, H, K, K1 and L
**Selection:** Rear panel thumbwheel system switches
**Chrominance Subcarrier:**
$f_{OB} = 4.250000$ MHz
$f_{OR} = 4.406250$ MHz
**Tolerance:** 30 p.p.m.
3 p.p.m. for PM 5418 TXI, PM 5418 TD(S)(I), PM 5420
Type of chrominance subcarrier modulation: Frequency modulation
Transmitted chrominance information: Line-sequential $D'_R$ and $D'_B$
**Signals:** $D'_R = -1.9\ (E'_R - E'_Y)$
$D'_B = -1.5\ (E'_B - E'_Y)$
**Amplitude:**
a) Fixed, according to standard
b) Continuously variable from 0 to 150%
**Frequency Deviation of Chrominance Subcarrier:** According to TV standard
**Video Pre-Emphasis:** Low frequency pre-correction and high-frequency bell filter according to TV standard
**Bell Center Frequency:** 4.286 MHz
**Tolerances:** 20 kHz

### Synchronization

**Identification:** According to TV system in line and frame
**Frame Identification:** Position in lines 7 to 15; in 1st, 3rd and 5th field etc.: in lines 320 to 328; in 2nd, 4th and 6th field etc.
**Line Identification:** By burst (chrominance subcarrier reference signal) on the back porch according to TV standard/SECAM B, D, G, H, K, K1, L)

**Amplitude:** Line and frame identification according to TV standard, but also variable between 0 to 150% together with chroma information

## PALplus PM 5420

**PALplus**

Signals comply with PALplus system description revision 3.0, January 1994 and are available in the standards PAL B, D, G, H and I. Please refer to appropriate section when parameter or function is not specifically mentioned.

**Operating:** Via frontpanel or IEEE-interface, automatically disabled when selecting PAL N, PAL M, NTSC, SECAM or one of the non-PALplus patterns

**Format:** Centered letterbox 16:9 with modulated helper lines

**Video:** As in non-PALplus mode, voltage is continuously variable between 0 to 1.5V (1V fixed)

**Chroma:** As in non-PALplus mode, amplitude (incl. burst and helper signals) is continuously variable from 0 to 150% (100% fixed)

**Modes:** Film and camera modes

**MACP:** Supported

**Signalling:** Full automatic widescreen signalling bits generation according to selected pattern

**References:** Helper reference burst in line 23

Black level reference in line 623

White level reference in line 623

**Teletext, PDC/VPS, Sound:** As in non-PALplus mode, PDC/VPS programming is disabled

## SOUND PM 5415, PM 5418, PM 5420

## MONO

**Sound Carrier:** On/off switchable

**Frequency:**

4.5 MHz, standard M, N;

5.5 MHz, standard B, G, H;

6.0 MHz, standard I;

6.5 MHz, standard D, K, K1 and L

**Tolerance:** 30 p.p.m.

**Vision/Sound Carrier Ratio:**

13 dB, standard B, G, H;

11 dB, standard D, K, K1, L;

13 dB, standard M, N;

12 dB, standard I

**Sound Modulation:** FM, internal and external on/off switchable, AM for SECAM L

**Pre-Emphasis:** 50 µs standard B, D, G, H, I, K, K1; 75 µs standard M, N

*Internal FM*

**Frequency Deviation:**

± 30 kHz, standard B, G, H;

± 15 kHz, standard M, N;

± 31 kHz, standard I;

± 27 kHz, standard D, K, K1

**Modulation Depth:** 50%, standard SECAM L

*External FM 0.4V will give the same deviation or modulation depth as with internal modulation*

**Input:** DIN connector, pin 3 + 5 (rear panel)

**Impedance:** 0.5 MΩ

**Bandwidth:** 40 Hz to 15 kHz

**Max Input Voltage:** ± 40V

**Output:** SCART connector (Euro-AV connector), pin 1+3 (rear panel)

**Impedance:** 1 kΩ

**Voltage:** 0.4V

## STEREO PM 5415 TX(S), PM 5415 TN(S), PM 5418 TX(S)(I), PM 5418 TD(S)(I), PM 5420

**Standards:** B, G

**Sound Carriers:** Carrier 1: 5.5 MHz; Carrier 2: 5.7421875 MHz

**Vision Sound Carrier Ratio:** Carrier 1: 13 dB; Carrier 2: 20 dB

**Frequency Tolerance:** 30 p.p.m.

3 p.p.m. for PM 5415 TN(S), PM 5418 TXI, PM 5418 TD(S)(I), PM 5420

**Modulation:** FM, internal and external on/off switchable

**Pre-Emphasis:** 50 µs

*Internal FM*

**Sound Channel 1:** 1 kHz or 3 kHz sinewave, on/off switchable

**Deviation:** ±30 kHz in mono/dual-channel; ±15 kHz in stereo, right channel switched off; ±30 kHz in stereo, left and right channels switched on with 1 kHz internal signal

**Sound Channel 2:** 1 kHz sinewave, on/off switchable

**Deviation:** ± 30 kHz

*External FM*

**Sound Channels 1 & 2 Input Voltage:** 0.4V will give the same deviation as the internal signal

**Inputs:** DIN connector (rear panel)

**Contacts:** Pin 2 (ground),

Pin 3 Sound channel 1

Pin 5 Sound channel 2

**Impedance:** 0.5 MΩ

**Bandwidth:** 40 Hz to 15 kHz

**Max. Permissible Voltage:** ± 40V

**Outputs:** SCART connector (Euro-AV connector)

**Contacts:** Pin 3 Sound channel 1

Pin 1 Sound channel 2

**Impedance:** 1 kΩ

**Voltage (rms):** 0.4V

*Operating Mode Detection*

**Pilot Frequency:** 54.6875 kHz ($3.5 \times f_H$)

**Tolerance:** 30 p.p.m.

3 p.p.m. for PM 5415 TN(S), PM 5418 TXI, PM 5418 TD(S)(I), PM 5420

**Modulation:** AM

**Modulation Depth:** 50%

**Identification Frequencies:**

117.5 Hz ($f_H$/133) stereo mode; 274.1.Hz ($f_H$/57) dual-channel mode

**Deviation of 2nd Sound Carrier:** ± 2.5 kHz by modulation of carrier with unmodulated pilot

## NICAM PM 5415 TN(S), PM 5418 TD(S)(I), PM 5420

**Modulation of the AM/FM sound carrier with NICAM off:** AM/FM MONO, FM DUAL or FM STEREO

**Modulation of the AM/FM soundcarrier with NICAM on:** AM/FM MONO carrier remains; FM STEREO carrier off

*Internal modulation of mono sound carrier*

**MONO and DUAL:** Same contents as NICAM channel 1

**STEREO:** Sum of NICAM channels 1 and 2

**FM Deviation:** ± 30 kHz

**Test:** Modulation off

*External modulation*

*As in normal mode, MONO sound RSSF automatically set to LOW*

*Digital Sound Section NICAM*

**Sound Carrier:** On/off switchable by selecting/deselecting the NICAM modes MONO, DUAL, STEREO, TEST

**Frequency:** System B, G, L: 5.85 MHz; System I: 6.552 MHz

Related to bit-rate clock. Automatically matched to chosen TV system

**Tolerance:** 3 p.p.m.

**Aging:** 2 p.p.m./year

**Amplitude:** −20 dBc (related to video carrier)

**Tolerance:** ± 2 dB

**Modulation:** Quadrature phase shift keying (QPSK)

**Modes:** MONO, DUAL, STEREO, TEST selectable

*Internal Sources*

**Channel 1:** 1 kHz or 3 kHz sinewave, on/off switchable

**Channel 2:** 1 kHz sinewave, on/off switchable

**Amplitude:** Two different amplitudes selectable by AMPL LOW key; FM deviation of MONO carrier remains at ± 30 kHz

**Amplitude High:** Reference is the maximum codeable amplitude at 15 kHz. 1 kHz and 3 kHz amplitudes are attenuated relative to this level according to preemphasis CCITT Rec. J17

**Amplitude Low:** ⅓ of high amplitude

**Reserve Sound Switching Flag (RSSF):** High/low selectable by RSSF LOW key. High/low selectable for all NICAM modes. Content of the FM modulated carrier is different from the QPSK modulated NICAM carrier, but it is not indicated

**Test 1:** NICAM demodulator test

**Test 2:** NICAM decoder test

**Test 3:** Unmodulated NICAM carrier

**Sound Coding:** 10 bits/sample and 32 samples/block according to NICAM-728

**Bit Rate:** 728 kbit/s ± 3 p.p.m.

**Pre-Emphasis:** CCITT Rec. J17

**Spectrum Shaping:** System B, G, L: 40%

## PM 5400 family of TV Signal Generators

cosine roll-off
System I: 100% cosine roll-off
**NICAM Data Output:** BNC rear panel
**Data Format:** According to NICAM-728
**Data Level (Vpp):** 1V at 75Ω
**Output Impedance:** 75Ω
**NICAM Clock Output:** BNC rear panel
**Frequency:** 728 kHz ± 3 p.p.m.
**Clock Amplitude (Vpp):** 1V at 75Ω
**Output Impedance:** 75Ω

*Analog sound section (NICAM)*
**Analog Output:** Euro-AV connector (SCART) rear panel
**Impedance:** 1 kΩ
**Output Voltage (rms):** 0.4V
**Internal Modulation:** Pin 3 Contents of channel 1
Pin 1 Contents of channel 2
**For RSSF Flag Low (both pins):** Modulation contents of the FM MONO channel
**External Modulation of FM Carrier Combined with NICAM Sound:** RSSF (Reserve Sound Switching Flag) automatically set to LOW
Pin 3 Signal supplied to pin 3 of the AUDIO IN connector
Pin 1 Signal supplied to pin 5 of the AUDIO IN connector

### MTS Stereo plus SAP (BTSC sound) PM 5415 BC, PM 5418 TD(S)(I), PM 5420

MTS Stereo and SAP (Second Audio Program) comply with the BTSC standard and are available in TV standards NTSC M and PAL M
**Sound Carrier:** On/off switchable
**Frequency:** 4.5 MHz
**Vision Sound Carrier Ratio:** 13 dB
**Modulation:** FM with BTSC Baseband
**Baseband:** Mono-channel (75µ pre-emphasis)
Stereo-channel, AM modulated with suppressed carrier (BTSC compressed)
SAP-channel, FM modulated (BTSC compressed)

*Internal Sources*
**Sound Channel 1:** 1 kHz or 3 kHz sinewave, on/off switchable
**Pilot:** On/off switchable
**Sound Channel 2:** 1 kHz sinewave, on/off switchable
**SAP Channel:** 5 kHz sinewave, on/off switchable
**Test 1:** Channel separation test/alignment
**Test 2:** Channel separation quality check
**Test 3:** Audio level test/alignment
**MPX Output:** BNC connector on rear panel
**Impedance:** 50Ω
**Voltage (rms):** 0.32V (into 50Ω)
**Channel Separation:** > 36 dB
**Sound Channel 1&2:** SCART connector (Euro-AV connector)
**Contacts:** Pin 3 Sound channel 1
Pin 1 Sound channel 2
**Impedance:** 1 kΩ
**Voltage (rms):** 0.36V for 54% modulation

### TELETEXT PM 5415 TX(S), PM 5415 TN(S), PM 5418 TX(S)(I), PM 5418 TD(S)(I), PM 5420

**TXT**
**Standards:** PAL B, D, G, H, I, N
SECAM B, D, G, H, K, K1, L
**Data Synchronization Frequency:** 6.9375 MHz (444 x $f_H$), standard PAL; 6.203125 MHz (397 x $f_H$), standard SECAM
**Data Coding:** According to standards (TOP, FLOF, Antiope)
**Signal Levels:** PAL: '1' = 66% of white level, '0' = black level
SECAM: '1' = 100% of white level, '0' = black level
**Signal Shaping:** Cos$^2$ filter
**Data Lines:** 20, 21, 333, 334
13, 14 , 20, 21, 326, 327, 333, 334 for PM 5415 TXS, PM 5415 TNS, PM 5418 TXS, PM 5418 TDS(I), PM 5420
**Data Contents:** Text pages with special contents for decoder testing for each standard
**Normal Working Mode:** Combinations possible with all test patterns

### Signal Output

**Teletext signal combined with video signal:** All CVBS outputs
**Modulated RF signal:** RF output, RF from basic unit

### PDC / VPS PM 5415 TXS, PM 5415 TNS, PM 5418 TXS, PM 5418 TDS(I), PM 5420

**PDC**
Program Delivery Control is a data broadcasting system which carries program related information for exploitation by suitably-equipped video recorders according to the EBU specification SPB 459 Revision 2
**Data Synchronization Frequency:** 6.9375 MHz
**Modulation:** Binary NRZ
**Data Coding:** According to standard
**Location of Data:** Lines 13, 14, 20, 21, 326, 327, 333, 334
**Signal Levels:** '0' = 0V, '1' = 66% of white level
**Signal Shaping:** Cos$^2$ filter
**Data Contents:** 9 different sets of PDC data of which 4 are freely programmable
**Normal Operating Mode:** Combination possible with all (except cross hatch) test patterns and teletext; on/off switchable
**Programming:** Via keyboard and text strip inserted in the test pattern
**Text Strip:** 6 different positions or not visible

**VPS**
Video Programming System for pre-programmed recording with home video recorders according to German broadcasting organizations ARD, ZDF and ZVEI
**Data Synchronization Frequency:** 5 MHz
**Bit Length:** 400 ns
**Modulation:** Bi-phase modulation
**Data Coding:** According to the guideline issued by ARD, ZDF and ZVEI
**Signal Levels:** '0' = black level, '1' = 71.4% of white level
**Signal Shaping:** Cos$^2$ filter
**Location of Data:** Line 16 (VPS system)
**Data Contents:** 9 different freely programmable non-volatile sets of VPS data preset at factory
**Normal Operating Mode:** Combination possible with all (except cross hatch) test patterns and teletext; on/off switchable
**Programming:** Via keyboard and text strip inserted in the test pattern
**Text Strip:** 6 different positions, or not visible

### Closed Caption PM 5415 BC, PM 5415 TXS, PM 5415 TNS, PM 5418 TXS, PM 5418 TDS(I), PM 5420

**CC**
Closed Caption is a subtitling system used in the USA (NTSC M).
**Data synchronization frequency:** 503.4965 kHz (32 * $f_H$)
**Data Coding:** Binary NRZ
**Signal Levels:** '0' = blanking level; '1' = 50 IRE level
**Signal Shaping:** filtered to a 2T response
**Location of Data:** line 21 of field 1 in the NTSC M system
**Data Contents:** 7 cycle sine wave clock run-in burst, start bit and 16 data bits
**Display Modes:** Pop On, Roll Up, Paint On and Text Mode
**Second Language:** Available
**Data Informations:** 8 pre-defined Closed Caption data sets, non-programmable.
1 sequence of these 8 pre-defined data sets is possible

### IEEE-488 Interface PM 5418 TXI, PM 5418 TDSI, PM 5420

**IEEE**
Allows selection and control of all functions, except: video, chroma and RF amplitude

### Y/C + RGB PM 5418 TXI, PM 5418 TDSI, PM 5420, instruments incl. option PM 9553G

**RGB**
**RGB Outputs:** BNC connectors (rear)
**Output Voltage (Vpp):** 0.7V into 75Ω
**Impedance:** 75Ω
**Subcarrier Output:** BNC connector (rear), only for PAL and NTSC
**Output Voltage (Vpp):** 2V into 75Ω
**Impedance:** 75Ω
**Sync. Output:** BNC connector (rear)
**Output Voltage (Vpp):** 2V into 75Ω
**Impedance:** 75Ω

# PM 5400 family of TV Signal Generators

### Y/C Signal

**Y/C Output:** 4-pin S-connector (rear panel)
**Y Signal (luminance):** Y signal at pin 3, Y ground at pin 1
**Impedance:** 75Ω
**Nominal Output Level:** 1 Vpp (into 75Ω)
**Tolerance:** 10%

| | | |
|---|---|---|
| **Standard:** | B, D, G, H, I, N, K, K1, L | M |
| **Sync. level** | −43%±3% | −40%±3% |
| **Blanking level** | 0% | 0% |
| **Black level** | 0% | 7.5%±2.5% |
| **White level** | 100% | 100% |

**C Signal (chroma):** Complete chroma signal including color burst of CVBS signal C signal at pin 4; C ground at pin 2
**Impedance:** 75Ω
**Output Level into 75Ω:** 100% ± 5% for PM 5415, PM 5418, PM 5420
100% ± 10% for PM 5414 V
**Setting Value:** 0 to 150% continuously adjustable for PM 5415, PM 5418, PM 5420; 0 or 100% switchable for PM 5414 V

## General Specifications

### PM 5414 V, PM 5415, PM 5418, PM 5420

**Environmental Conditions:**
**Temperature**
**Operating:** +5°C to +50°C
**Non-operating:** −40°C to +70°C
**Humidity:** +5°C to 10°C is not controlled
+11°C to 30°C is 95%[1])
+31°C to 40°C is 75%[1])
+41°C to 50*C is 45%[1])
[1]) Acc. to MIL-T-2880D
**Reliability:** MTBF = 20,000 hours
**Safety:** IEC 1010-1 Class I
CSA-C22.2 No 231
**EMC:** EN 55011, VDE 0871 Level B, FCC Part 15J Class A

### Power Requirements:

**Selectable:** 100 V, 120 V, 220 V, 240 V ± 10%; 50 Hz / 60 Hz ± 5%; 35 to 72 VA depending on model and installed option.

### Mechanical Data:

**Width:** 300 mm (11.8 in)
**Height:** 140 mm (5.5 in)
**Depth:** 400 mm (15.7 in)
**Weight:** Net 6.5 to 8.6 kg (14.4 to 19.0 lb)
Shipping 10 to 12.7 kg (22.2 to 28.0 lb) depending on model and installed options

## Ordering Information

### Basic Models

(See selection guide for configuration)

| Main models | Description | Price |
|---|---|---|
| PM 5414V-n | PAL / NTSC Video pattern generator (video only), no sound and no RF-output | *$1450* |
| PM 5415-n | PAL / NTSC TV-signal generator, including: 16:9 aspect ratio, sound and RF-output | *$2710* |
| PM 5418-n | PAL / NTSC / SECAM TV-signal generator, including: 16:9 aspect ratio, sound and RF-output | *$3410* |
| PM 5420/00N | PAL/PALplus / NTSC / SECAM TV-signal generator, including: 16:9 aspect ratio, stereo sound, RF-output, teletext and Y/C | *$10500* |

The **n** indicates the required line cord. To select your line cord substitute the **n** by:
1 Universal Euro 220V/16A. 50 Hz
3 Standard North American 120V/15A, 60 Hz
4 UK 240V/13A, 50 Hz
5 Switzerland 220V/16A, 50 Hz
8 Australia 240V/10A, 50 Hz

### Included With Instrument

| Models | Description |
|---|---|
| PM 9538 | RF cable<br>BNC TV connector 75Ω<br>Power Cord |
| PM 5414 | Operating manual |
| PM 5415/<br>PM 5418 | Operating manual |
| PM 5420 | Operating manual |

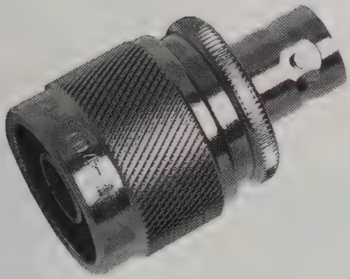
### Accessories

**PM 9539/01:** RF cable and 300Ω trafo *$55*
**PM 9575:** 75 Ω BNC-BNC Cable *Contact Factory*
**PM 9546:** Universal Chroma Unit** *$325*
**PM 9553 G:** Y/C + RGB Output
** *Contact Factory*
**PM 9561 G:** 19" Rackmount *$240*
**PM 5414** Service manual
P/N 102068 *$75*
**PM 5415/PM 5418** Service manual
P/N 948455 *$75.00*
** Service center installable only

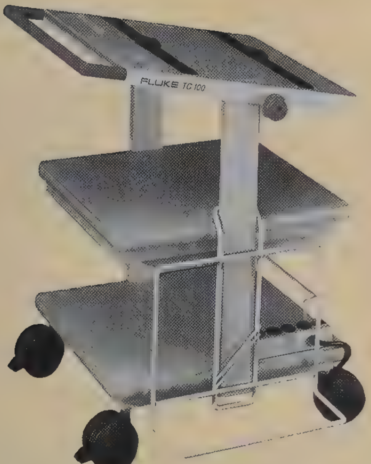
FLUKE

# General Accessories

This section includes an assortment of general instrument accessories that are compatible with a wide variety of Fluke instruments and products. Also refer to the individual product sections in this catalog, as well as the alphabetical index, for specifications and ordering information on other accessories designed specifically for use with particular products.



Adapters



Cart

Test Leads

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11

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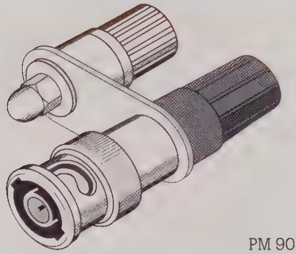
# General Accessories

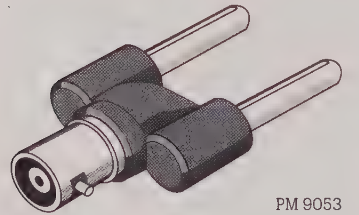
## Adapters and Connecters



PM 9051

### BNC - Banana Adapter

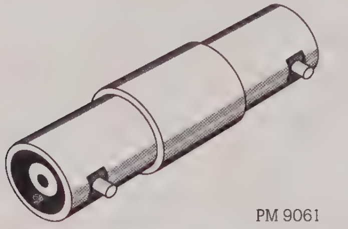
**PM 9051** Adapter BNC (m), 4 mm Banana (f) ***$27***



PM 9053

### BNC - Banana Adapter

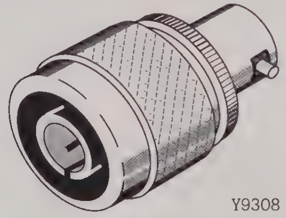
**PM 9053** Adapter BNC (f), 4 mm Banana (m) ***$22***



PM 9061

### BNC - BNC Adapter

**PM 9061** Adapter BNC (f) - Banana (f) ***$27***

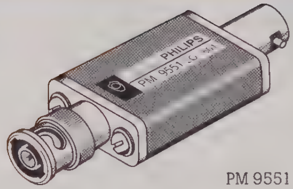


Y9308

### Type N to BNC Coaxial Adapter

This accessory provides an interface between one coaxial connector series and another.

**Y9308** Adapter, Type N (m) to type BNC (f), 50Ω ***$35***

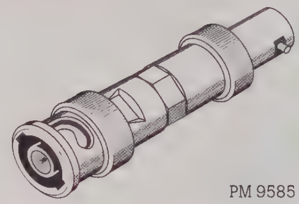


PM 9551

### Adapter

50Ω to 600Ω Adapter for all generators.

**PM 9551** 50Ω to 600Ω Adapter ***$105***



PM 9585

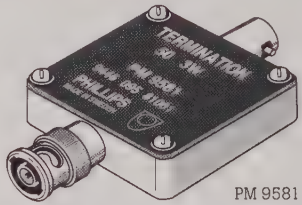
### Feedthrough Termination

BNC to BNC 1W feedthrough terminator.

**DC Resistance:** 50Ω ±1%

**Max. VSWR:** 1.1 from dc to 100 MHz, 1.2 from 100 to 250 MHz

**PM 9585/011** 50Ω Feedthrough Termination, 1W ***$60***



PM 9581

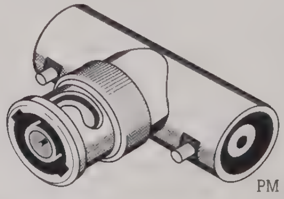
### Feedthrough Termination

BNC to BNC 3W feedthrough terminator.

**DC Resistance:** 50Ω ±1%

**Max. VSWR:** 1.1 from dc to 100 MHz, 1.2 from 100 MHz to 250 MHz

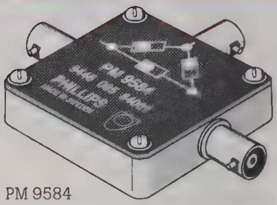
**PM 9581/011** 50Ω Feedthrough Termination, 3W ***$100***



PM 9067

### T-Connector, BNC

**PM 9067** T-piece, BNC (1x m, 2x f) ***$27***



PM 9584

### T-Connector

BNC to BNC matched power splitter.

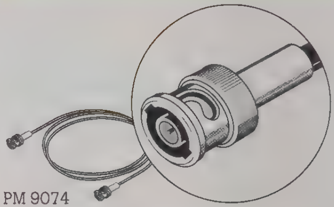
**Voltage Attenuation Ratio:** 2x (both outputs terminated in 50Ω)

**DC Resistance:** 50Ω ±1% in each load arm

**Maximum Input Power:** 4W

**PM 9584/021** 50Ω T-Connector ***$95***

## Cables



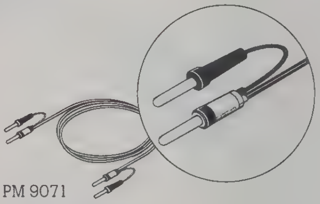
PM 9074

### BNC Coaxial Cables

Coaxial cables with BNC connectors (plugs) on each end.

**PM 9074** BNC Coaxial Cable 50Ω 1m (3.28 ft) ***$27***

**PM 9075** BNC Coaxial Cable 75Ω 1m (3.28 ft) ***$27***



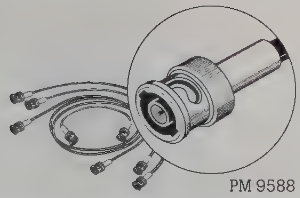
PM 9071

### Coaxial Cables

**PM 9071** Banana to Banana Cable 135Ω, 1m (3.28 ft) ***$65***

**PM 9072** Banana to Banana Cable 135Ω, 1m (3.28 ft) ***$65***

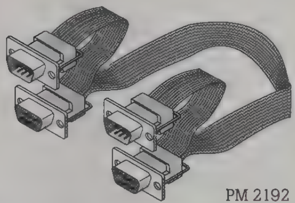
# General Accessories



PM 9588

## Coaxial Cable Set

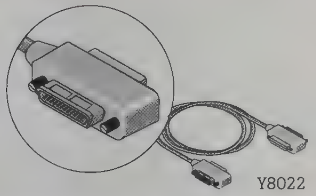
Set of 15 pcs, 50Ω coaxial cables with BNC connectors (plugs) on each end. Length defined as delay time; 5 pcs × 1 ns, 4 pcs × 2 ns, 4 pcs × 3 ns, 3 pcs × 10 ns.
**PM 9588/011** 50Ω Coaxial Cable Set *$375*



PM 2192

## Bus Extension Cable

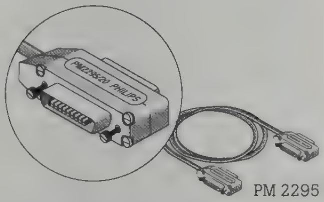
**PM 2192/011** Bus Extension Cable *$90*



Y8022

## IEEE-488-Compatible Cables

A series of cables in three lengths are used to connect instruments to each other and to the IEEE-488 Bus. Each cable end has both a plug and a jack and are shielded.
**Y8021** Shielded IEEE-488 Cable 1m (3.28 ft) *$195*
**Y8022** Shielded IEEE-488 Cable 2m (6.56 ft) *$210*
**Y8023** Shielded IEEE-488 Cable 4m (13 ft) *$220*

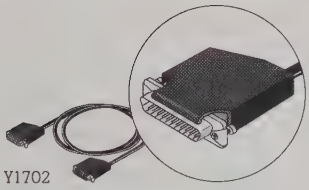

PM2295/20 PHILIPS

PM 2295

## GPIB-IEEE Cables*

**PM 2295/05** Cable GPIB-IEEE, 0.5m (1.64 ft)
**PM 2295/10** Cable GPIB-IEEE, 1m (3.28 ft)
**PM 2295/20** Cable GPIB-IEEE, 2m (6.56 ft)

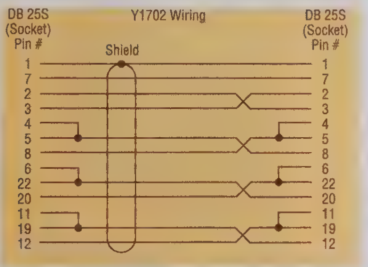
* Limited availability in European countries only

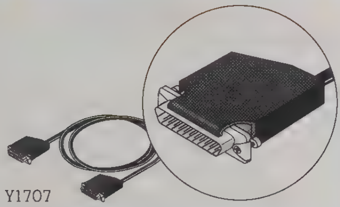


Y1702

## RS-232C Cables

These cables are to connect instrument controllers, terminals, modems, printers, etc. to other similar equipment compatible with EIA Standard RS-232C.
**Y1702** Null Modem Cable 2m (6.56 ft) *$180*

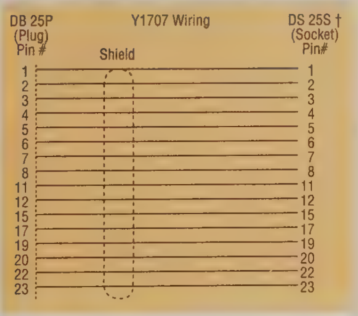

DB 25S
(Socket)
Pin #
Y1702 Wiring
DB 25S
(Socket)
Pin #
Shield
1
7
2
3
4
5
8
6
22
20
11
19
12
1
7
2
3
4
5
8
6
22
20
11
19
12



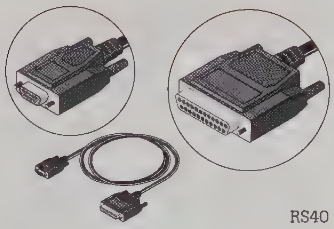
Y1707

## RS-232C Cables

**Y1707** Interface Cable 2m (6.56 ft) *$180*


DB 25P
(Plug)
Pin #
Y1707 Wiring
DS 25S †
(Socket)
Pin#
Shield
1
2
3
4
5
6
7
8
11
12
15
17
19
20
22
23
1
2
3
4
5
6
7
8
11
12
15
17
19
20
22
23

† TDB 25P for Y5003 and Y5004



RS40

## RS-232C Cable

**RS40** RS-232C Terminal Cable 1.83m (6 ft) (DB-9 to DB-25 female connector, connects to PC, PC/XT or PS/2)* *$30*

| | Connector A | | Connector B | |
|---|---|---|---|---|
| | DB-9S | | DB-25S | |
| | Pin | | Pin | RS-232 Name of Computer |
| 45 | 1 | | 20 | Data Terminal Ready* |
| RX IN | 2 | ← | 2 | Transmitted Data |
| TX OUT | 3 | → | 3 | Received Data |
| DTR OUT | 4 | → | 6 | Data Set Ready |
| COM | 5 | — | 7 | Signal Ground |
| | 6 | | 20 | Data Terminal Ready* |
| | 7 | | 5 | Clear to Send* |
| | 8 | | 4 | Request to Send* |
| | 9 | | Not used | Ring Indicator* |

**Optional - may be omitted (unused).*
*All other sockets not listed are unused.*

## RS-232C Cable

**RS41** RS-232C Modem Cable (6′) (DB-9 to DB-25 male connector) *$30*

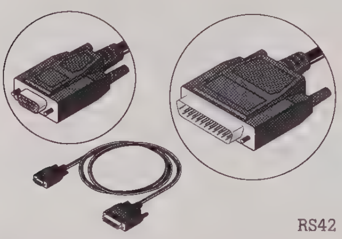
| | Connector A | Connector B | |
|---|---|---|---|
| | DB-9S | DB-25P | |
| | Pin | Pin | RS-232 Name |
| 45 | 1 | 8 | Carrier Detect |
| RX IN | 2 | 3 | Received Data |
| TX OUT | 3 | 2 | Transmitted Data |
| DTR OUT | 4 | 20 | Data Terminal Ready |
| COM | 5 | 7 | Signal Ground |
| | 6 | 6 | Data Set Ready |
| | 7 | 4 | Request to Send |
| | 8 | 5 | Clear to Send |
| | 9 | 22 | Ring Indicator |

## RS-232C Cabling Guide

With the addition of Hydra models to our product line, the possible combination of instruments and RS-232C cables have multiplied. To help sort things out we have supplied a table showing which cables work with which models. Cable diagrams are also supplied for the do-it-your-selfers.

| **Connect To:** | **PC, PC/XT** | **17XXA** | **PC/AT** | **Modem** | **Printer** |
|---|---|---|---|---|---|
| **Model** | | | | | |
| 2286A/2285B | Y1702 (1) | Y1702 (1) | Adapter (3) + Y1702 (1) | Y1707 (2) | Y1709 |
| 262XA (Hydra) | RS40 | RS40 | RS40 + RS41 | RS41 -- | RS42 |
| 2289A/2287A (Helios) Toolbox & General Use | Y1702 (1) | Y1702 (1) | Adapter (3) + Y1702 (1) | Y1707 (2) | Y1709 |
| with LTN | Y1702 (1) | – | Adapter (3) + Y1702 (1) | – | Y1709 |
| with CIMPAC | Y1702 (1) | – | Y1702 (1) | – | Y1709 |
| 2400B | Y1702 (1) | Y1702 (1) | Adapter (3) + Y1702 (1) | Y1707 (2) | Y1709 |
| 17XXA | – | – | – | Y1707 (2) | Y1709 |

(1) Y1702 is 2 meters long or use Y1703 (4 meters) for extra length. The Y1705 + Y1707 (2) may also be used/.
(2) Y1707 is 2 meters long or use Y1708.(10 meters) for extra length.
(3) 9 to 25 pin adapter is easily available. We have never seen one which will not work. Should match diagram on the previous page.


RS42

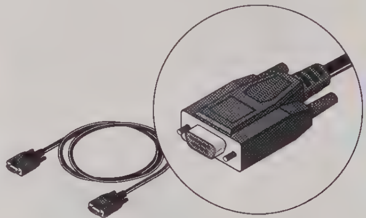
## RS-232C Cable

**RS42** RS-232C Printer Cable (6′) (DB-9 to DB-25 male connector, connects to PC, PC/XT or PS/2)* ***$35***

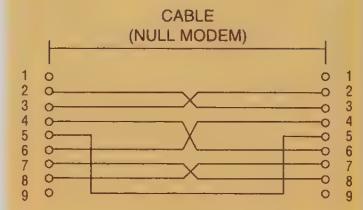
Connector
A B

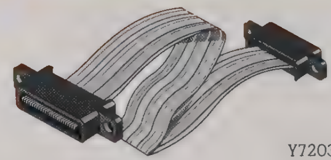
| | DB-9S | DB-25P | |
|---|---|---|---|
| | Pin | Pin | RS-232 Name of Computer |
| 45 | 1 | 20 | Data Terminal Ready* |
| RX IN | 2 | 2 | Transmitted Data |
| TX OUT | 3 | 3 | Received Data |
| DTR OUT | 4 | 6 | Data Set Ready |
| COM | 5 | 7 | Signal Ground |
| | 6 | 20 | Data Terminal Ready* |
| | 7 | 5 | Clear to Send* |
| | 8 | 4 | Request to Send* |
| | 9 | Not used | Ring Indicator* |

**Optional - may be omitted (unused).*
*All other sockets not listed are unused.*



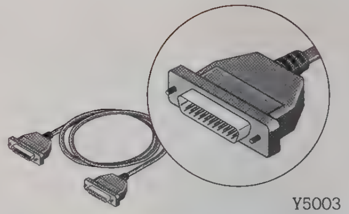
**RS43** RS-232 Cable to connect Hydra 2620A, 2625A, 2635A to a Personal Computer 9 pin serial port, supporting full hardware (7 wire) handshake. ***$45***




Y7203

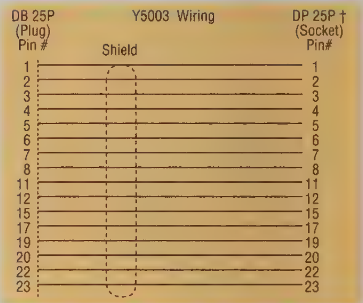
## Ribbon Cables

**Y7203** Ribbon Cable, PTI, 0.6m (2 ft) ***$70***
**Y7204** Ribbon Cable, PTI, 1.52m (5 ft) ***$80***

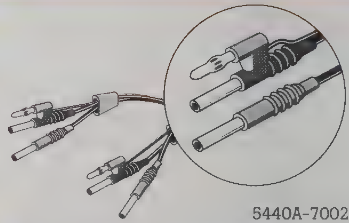

Y5003

## Interface Cables

**Y5003** Interface Cable 1.52m (5 ft.) ***$185***



# Test Leads

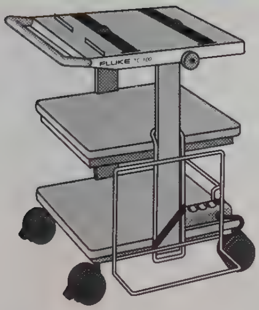

5440A-7002

## Low Thermal Test Leads

These low thermal test leads have lower thermal emf than standard test leads, minimizing the emf caused by temperature difference between the ends of the leads.
**Length:** 24 in ±1 in, 48 in ±1 in. There are three test leads in the set: two 24″ leads and one 48″ lead.
**Connector Size:** 4 mm diameter
**Connector Style:** Safety type, with a retractable spring-loaded hood. The connector engages with a wiping action.
**Thermal EMF:** Less than 1.3 $\mu$V per °C when measured while engaged in a five-way binding post of Tellurium Copper Alloy 145, half hard.
**Leakage Resistance Between Center Conductor and Shield:** Greater than 1.0 × $10^{13}\Omega$ at 45°C and 75% R.H.
**Cable Type:** RG-58/U type with AWG 20 stranded and tinned center conductor (19 × .0071 in) (Belden 8262 or equivalent).
**Safety Ratings:** Designed to meet UL 1244 to 1100V ac
**5440A-7002** Low Thermal Test Leads ***$475***

# General Accessories

## Cart



### Instrument Transport Cart

The TC100 Instrument Cart* provides three levels of work surface, all of them accommodating 19″ wide instruments. It easily combines an oscilloscope or other instruments, and a printer plus paper supply, on one easily movable work station. The top shelf is adjustable over 25 degrees, and has a safety lock. The cart has a 300 lb capacity.

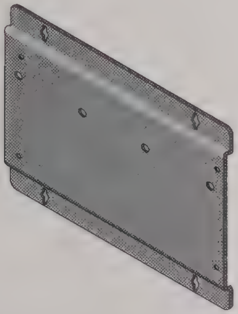
Four 4″ casters, two of which can be locked, provide excellent mobility, and options include a line power strip, accessories drawer, and a CPU bracket.

**TC100** Instrument Cart ***$540***
**TC100-01** Opt. Power Strip, 4 outlets, UL listed ***$45***
**TC100-02** Opt. Drawer ***$80***
**TC100-03** Opt. CPU Bracket ***$80***
**TC100-04** Opt. Combination of Power Strip, Drawer, and CPU Bracket ***$165***
**Drawer Size:** 17.75″ W × 19.5″ D × 3″ H
**CPU Bracket Size:** 15″ W × 5.5′ D × 17″ H

* Available in North America only

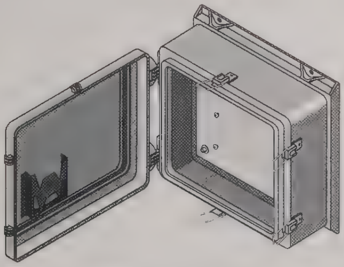
## Rack Mount Kits

Details on the most popular rack mount kits for Fluke products are included in this section, along with pertinent dimensions, drawings, model numbers and prices. Please also refer to the actual product pages in the catalog for further information; instruments that have kits available will list the kit model number in the Ordering Information block at the end of each product page. Any further questions should be directed to your closest sales office.



### Y2642 Wall/Cabinet Mounting Plate

**Y2642** Allows NetDAQ to be permanently mounted on a wall, or in a rack or cabinet. ***$70***

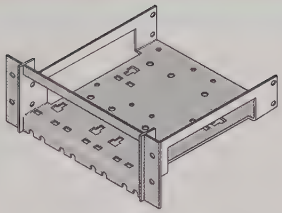


### Y2644 NEMA 4x (IP65) Enclosure

**Y2644** Protects a NetDAQ instrument from hazardous conditions, such as caustic or toxic environments, high temperatures or humidity. Provides durable protection and easy access. ***$480***

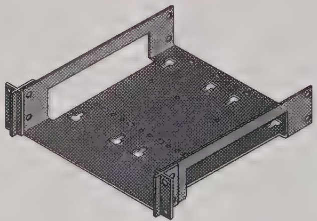
### Rack Mount Kit HM 9606/00

The HM 9606 rack kit is designed for use with the PM 2534/35 family of DMMs. The HM 9606/00 allows mounting of one PM 6665/6/9 Counter plus one PM 2534/35 DMM or one 8840/42 DMM.
**Height:** 3E (133 mm, 5.22″)
**HM 9606/00** Rack Mount Kit ***$185***



### PM 2193/031 19-inch Rack Mount

Can contain up to 8 System 21 units or a combination of 1 PM 2525, PM 2534 or PM 2535 DMM with 4 System 21 units. Unused space can be covered with PM 2194/02 Blank Panels (set of 7).
**Height:** 3E (133 mm, 5.22″)
**PM 2193/031** Rack Mount ***$325***



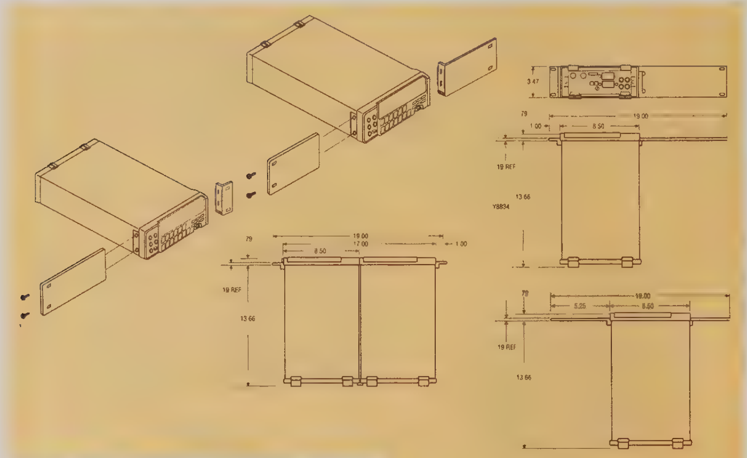
### PM 9280/041 19-inch Rack Mount

Also fits PM 2534/PM 2535 and up to four System 21 modules.
**Height:** 2E (89 mm, 3.5″)
**PM 9280/041** Rack Mount ***$345***

# General Accessories

## 8840 Series Multimeters

Models 8840A and 8842A can be mounted in a standard 19-inch rack panel using either single, dual or center Rack Mount Kit. External dimensions for the kit are provided to help you determine space requirements.

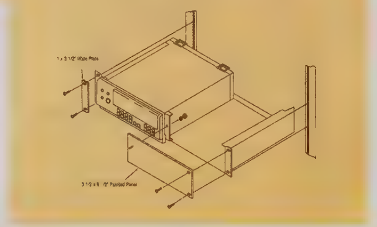


**Y8834** 3½″ Rack Mount Kit, Single *$90*
**Y8835** 3½″ Rack Mount Kit, Dual *$155*
**Y8836** 3½″ Rack Mount Kit, Center *$90*
Note: Kit includes all required hardware

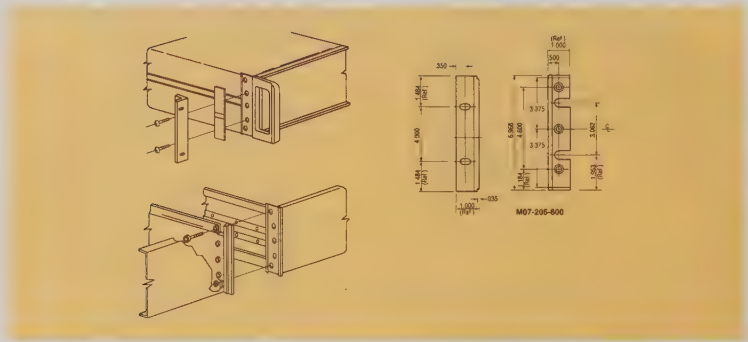
## Fluke Hydra Series

The Fluke Hydra Series can be mounted in a standard 19-inch rack panel on either the right or left hand side using the Fluke M00-200-634 Rack Mount Kit.

**M00-200-634** Rack Mount Kit *$122*



## Modular Series Instruments

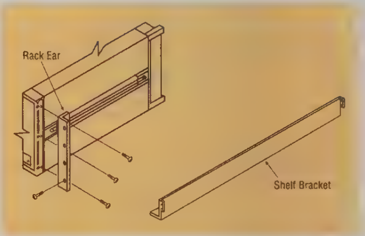


| Model (1) | Module Height mm (inch) | Instrument Description | Rack Ears Qty. | For Use On | Price |
|---|---|---|---|---|---|
| M07-205-600 | 177.0 (7) | | 2 | 5200A, 5220A | *$175* |
| M07-200-603 | 177.0 (7) | Side-by-Side | | 732 & 752A | *$175* |

(1) Rack Slides are not included unless otherwise stated

## 2280 Series

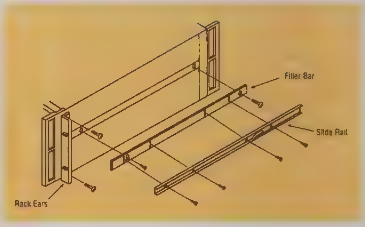
The Y2044 Rack Slide Kit facilitates the servicing of the instrument while it is installed in a standard 19-inch electronic equipment rack. The unit is secured in the equipment rack, yet may be pulled out along the slide for reconfiguring of serial link devices and servicing. The Y2045 Rack Mount Kit facilitates the placement of an instrument into a standard 19-inch rack.



**Y2044** Rack Slide Kit w/24″ Slides *$235*
**Y2045** 8¾″ Rack Mount Kit *$180*

## 734A & 5700 Series

The 734A, 5700A Calibrator or the 5725A Amplifier are mountable in a standard 19.12-inch panel opening E.I.A. universal spacing equipment rack. Model Y734 is for the 734A. Model Y5737 is for the 5700A and 5790A. Model Y5735 is for the 5725A. Kit contents and instructions for installation are the same for both kits, except for the size of the rack ears and usage of filler bar to slide rail mounting holes.



**Y5735** Rack Mount Kit w/24″ Slides *$450*
**Y5737** Rack Mount Kit w/24″ Slides *$450*

## Rack Slides

The units in the previous pages with a M00- number have provision for rack slides. These slides are the M00-260-610 (18″ long), M00-270-610 (20″ long), and M00-280-610 (24″ long).

These are devices allowing the instrument to be pulled straight out, after panel screws are removed, for servicing. They are normally only put on larger heavier instruments that can't be easily lifted out to a workbench. The rack slides are bolted to the side of the instrument and Fluke units with provisions for slides have matching tapped holes under a decorative strip on each side.

In order to match with the holes in the panel rail, rack slides are mounted in the center of a 1¾″ module. Instruments whose panel height is an odd number of 1¾″ modules has rack slides on the center line. Those with an even number have the slides ⅞″ above or below the center line. The Fluke M00 slides have provisions for this ⅞″ offset.

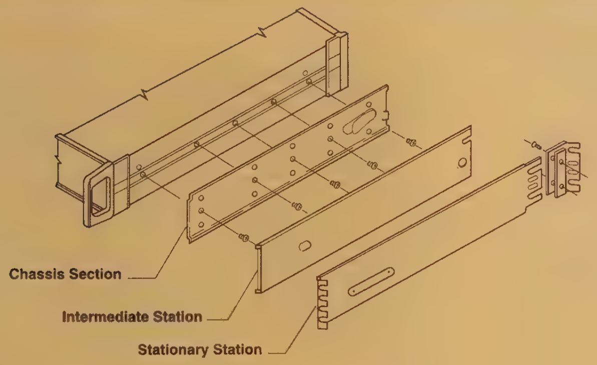
Three slide kits are available, one for 18″ racks, 20″ racks (between front and rear cabinet panel rails) and one for 24″ racks. Both have rear brackets with 1½″ adjustments.

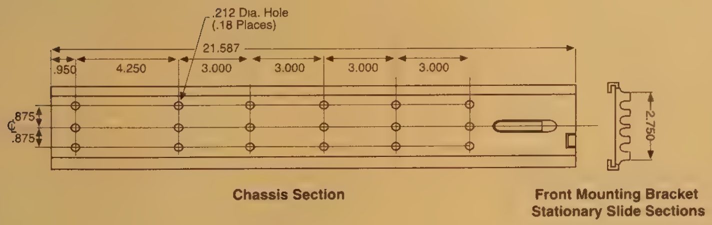
**Matl:** Hard, cold rolled steel.

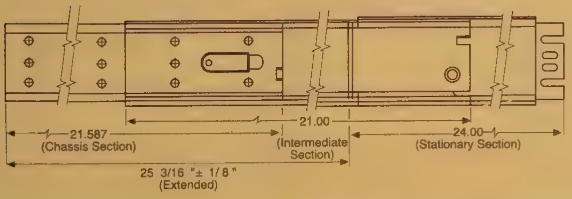
**Finish:** Cadmium plated. Will withstand JAN 100 hr. salt spray.

**Load Capacity:** 125 lb may vertical load per pair when extended.

Note: When ordering slides, the Rack Mount Kits are also required, unless it is one of the combination Rack Mount/Rack Slide Kits (Y1790, & 6061, Y7206, Y8598, M00-200-626, and M00-203-631).


Chassis Section
Intermediate Station
Stationary Station


.212 Dia. Hole
(.18 Places)
21.587
.950
4.250
3.000
3.000
3.000
3.000
.875
℄
.875
2.750
Chassis Section
Front Mounting Bracket
Stationary Slide Sections


21.587
(Chassis Section)
21.00
(Intermediate
Section)
24.00
(Stationary Section)
25 3/16 "± 1/8 "
(Extended)

| Order No.* | Height | Chassis Section (A) | Extension (B) | Intermediate Section (C) | Stationary Section (D) | Price |
|---|---|---|---|---|---|---|
| M00-260-610 | 3½ | 17 | 22¼ | 17 | 18 | $195 |
| M00-270-610 | 3½ | 19 | 22¼ | 17 | 20 | $195 |
| M00-280-610 | 3½ | 23 | 26¼ | 21 | 24 | $195 |

* Rack Mount Kits are required when ordering Rack Slides

Note: All mounting hardware furnished

# General Accessories

## Selection Guide for Fluke 19″ Wide Rack Mounts

| Models | Recommended Rack Mount | Height (1) | Blanking Panel |
|---|---|---|---|
| System 21 only (8 units max) | PM 2193 | 3E | PM 2194/02 (2) |
| System 21 combined with other models | PM 2193 (3) | 3E | PM 2194/02 (2) |
| PM 2525 | PM 2193 (3) | 3E | not included |
| PM 2534/35 | PM 9280 (5) | 2E | included |
| PM 2811 | PM 9280 (5) | 2E | included |
| PM 2812/13, PM 2831/32 | rack mount ears standard | 2E | not needed |
| PM 3050/55/65/70 | PM 8969/001 | 3E | included |
| PM 3052/57/67/72 | rack mount ears standard | 3E | not needed |
| PM 3082/84/92/94 | PM 8960/041 | 4E | included |
| PM 3331/35/50/50A/55/65A/75 | PM 8969/001 | 3E | included |
| PM 3337/52A/67A/77 | rack mount ears standard | 3E | not needed |
| PM 3370A/80A/82A/84A/90A/92A/94A | PM 8960/041 | 4E | not needed |
| Fluke 45 | PM 9280 (5)<br>Y8835 (6) | 2E<br>2E | included<br>included |
| PM 5138A/39 | PM 9563 | 3E | not needed |
| PM 5150 | PM 9564 | 2E | not needed |
| PM 5190 | PM 9560 | 4E | not needed |
| PM 5191/92/93 | rack mount ears standard<br>PM 9613/01 – optional slide kit | 2E | not needed |
| PM 5414V/15/18/20 | PM 9561G | 4E | included |
| PM 5786 | PM 9561 | 4E | included |
| PM 6303A, PM 6304/06 | PM 9564 (7) | 2E | not needed |
| PM 666x | HM 9606/00<br>PM 9280 (5) | 3E<br>2E | included<br>included |
| PM 666x (1 unit) | HM 9606/01 | 3E | included |
| PM 666x (2 units) | HM 9606/03 | 3E | included |
| PM 6680B, PM 6681, PM 6685R | PM 9622/00 | 2E | included |
| PM 6685 | PM 9622/02 | 2E | included |
| Fluke 8840/42 | PM 9280 (5)<br>Y8835 (6) | 2E<br>2E | included<br>included |

(1) Height that the rack mount plus the instrument(s) will take up in the rack. E = 1 Engineering Unit = 1.75 inches = 44.5 mm.

(2) PM 2194/02 contains 4 blanking panels: 1 1.5E high panel to blank 4 spaces at the top of the PM 2103/02 rack mount, and 3 1E high panels to blank 3 individual spaces.

(3) Up to 4 System 21 units can be rack mounted with one of any of the following models: Fluke 45, Fluke 8840A, Fluke 8842A, Hydra, PM 2525, PM 253x, PM 666x or PM 2811.

(4) HM 9606/00 and HM 9606.02 can alternatively hold the following DMMs: Fluke 45, Fluke 8840A or Fluke 8842A or Hydra.

(5) Any combination of 1 or 2 of the following instruments can alternatively be rack mounted using the PM 9280/04: Fluke 45, Fluke 8840A, Fluke 8842A, PM 2811, Hydra, PM 666x or PM 253x. NOTE: The PM 2525 will not fit in this rack mount, use PM 2193.

(6) Side by side mounting of Fluke 45, PM 8840A, PM 8842A, or Hydra is not possible in rack mount PM 9280, use Fluke dual rack mount Y8835.

## Ordering Information

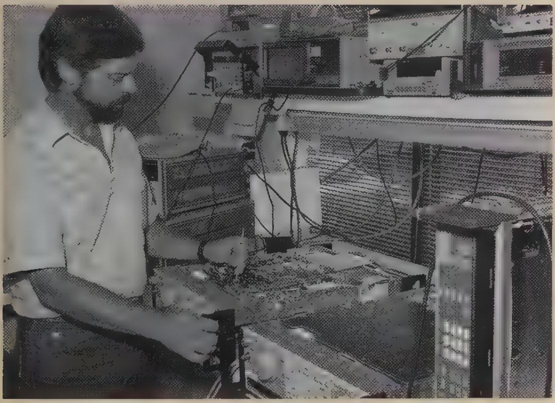
### Models*

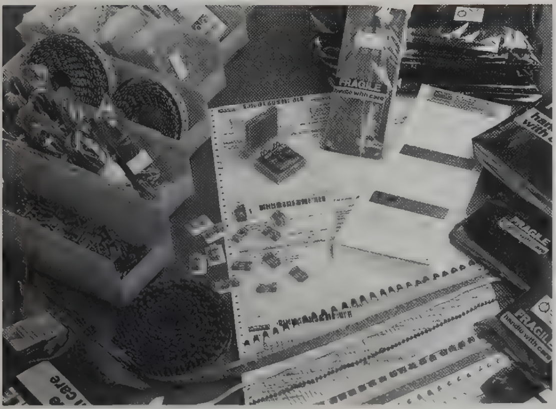
| | |
|---|---|
| **HM 9606/00** | *$185* |
| **HM 9606/01** | *$175* |
| **HM 9606/02** | *$200* |
| **HM 9606/03** | *$185* |
| **PM 2193/03** | *$325* |
| **PM 8960/04** | *$275* |
| **PM 8969** | *$330* |
| **PM 9280/04** | *$345* |
| **PM 9560** | *$240* |
| **PM 9561** | *$190* |
| **PM 9563** | *$240* |
| **PM 9564** | *$240* |
| **PM 9613/01** | *$325* |
| **PM 9622/00** | *$170* |
| **PM 9669/01** | *$145* |
| **PM 9669/02** | *$195* |

* Contact your local Fluke Sales Office for additional information and drawings on PM number rack mounting.

# Customer Support Services

Calibration & Repair


Standard Price Repair


Replacement Parts

**World-Class Products, World-Wide Support**

As ISO standards for development and manufacturing processes become more and more important for manufacturers to compete in the world marketplace, our customers require more frequent assurance their development, test, and manufacturing tools are functioning properly. Fluke is more than a manufacturer of high quality electronic test tools. We are also dedicated to providing high quality services to support our products in your applications. To protect your product investment, Fluke Service Centers are located at strategic locations worldwide to support you with calibration, repair, and self maintenance services, including service parts, manuals, and product upgrade kits.

To ensure you realize maximum productivity from your equipment and assist you in building the base for your own ISO quality management program, Fluke is committed to help you achieve the highest possible quality standards. We can help you keep your test, measurement, and calibration equipment at consistently high levels of operation and accuracy. Fluke is dedicated to ISO standards in controlling our own processes and quality of support.

Accredited calibration laboratories in Everett, WA, Toronto, Canada, Singapore and most calibration laboratories in Europe, are approved by and traceable to the National Standards Institutes of their respective countries.

## Contents

**Calibration & Repair**
Page 202
**Standard Price Repair**
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**Replacement Parts**
Page 203
**Extended Warranty Service**
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**Discontinued Products**
Page 204

# Customer Support Services

## Calibration & Repair

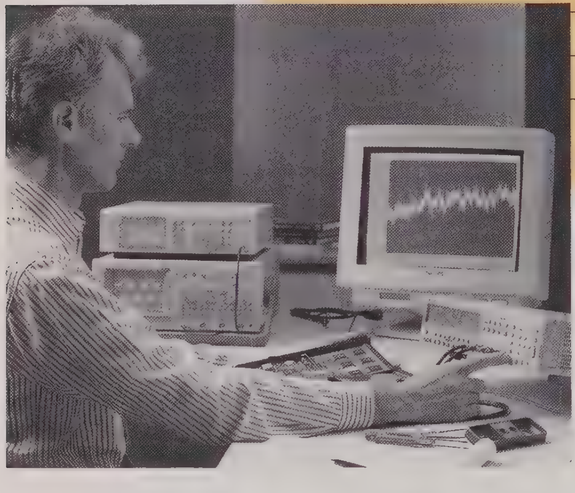
Variety of services to meet each customer's needs

Installation of product improvements

Calibration and/or alignment traceable to National Standards

Documented quality assurance program

Special calibration data available



Each Fluke Service Center is equipped with the necessary instruments, standards, procedures, and personnel to maintain Fluke products at peak performance. Proper use of measurement standards is carefully and continually monitored through a corporate controlled audit program.

Fluke's Customer Support Services group is dedicated to a single goal: providing the best possible service for both our products and our customers.

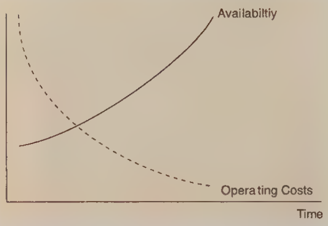
Every service is designed to meet a different level of product support, whether it's a single unscheduled repair or a full service agreement.

### It Pays to Calibrate Regularly

Measuring instruments are the 'heartbeat' of your company as they check and measure your production process. They control the quality of your products and are thus in the end responsible for the success and the profitability of your business.

A regular check of your 'heartbeat' with traceable calibration equipment is essential. First, it ensures your quality always matches the customer's expectations which is vital where ISO 9000 certification is involved. Second, regular calibration pays dividends.

The advantages of regular calibration are:
- Consistent quality of your production output
- Lower operating cost due to enhanced reliability
- Optimal access to international markets
- Establishing a quality system
- Address quality audit and reviews
- Maintain quality of specifications
- Meet production control criteria
- Measure inspection and testing results
- Establish calibration traceability



Calibration optimizes your process control

### ISO 9000: Traceable Calibration

'Calibration' means that the test results from a measuring device (or source) of unknown accuracy, are compared with a device whose accuracy is known. This device is universally accepted as a 'reference' and traceable to international standards. Calibration records any deviation from this standard and corrects it when necessary. Each instrument has a specific calibration procedure which indicates exactly how and what must be checked.

Regular and traceable calibration combines the forces of accuracy and certainty and provides you with the key aspect of ISO 9000 registration. Contact your nearest Fluke Service Center for more information on these services.

### CalNet®: The European Specialist in Calibration

Fluke has set up more than a dozen calibration laboratories all over Europe, which work together as a single network.

CalNet can issue the calibration certificates you need to meet ISO 9000 standards. CalNet guarantees traceability and access to the best calibration facilities the network can offer. Because of constant information exchange and comparing standards within the network, traceability increases while inaccuracy and uncertainty decreases.

CalNet is able to help you meet the calibration needs of not only equipment made by Fluke but also other manufacturers' products. It is a network that provides you with some real key advantages:
- CalNet laboratories are approved by and traceable to the National Standards Institutes.
- Each laboratory is a link in the chain of an active network. Sharing information, expertise and the same quality standards.

The need for calibration is directly related to the specific tasks performed by your equipment. CalNet is able to provide you with services tailored to your need which include:
- Performance verification check for simple test equipment. The CalNet sticker placed on your instrument after testing is your guarantee that it operates as specified.
- CalNet Certificate including a calibration report. When you need to know the exact results of the calibration.
- National calibration certificate if you need direct traceability to the National Standards Institutes.
- CalNet offers complete inventory and maintenance management of your installed test and measuring equipment including equipment of other manufacturers. One address for all your equipment maintenance and service needs.

## Special Services

- Calibration documentation
- Fast emergency service
- Handle all your service needs with one simple plan

Please contact your nearest Fluke Service Center for local availability and terms of this service.

## Standard Price Repair

- One-time repair or calibration at a fixed price
- Added support for your own maintenance program
- Take advantage of Fluke's expertise and resources on an as-needed basis

These cost-effective services can be used to repair or calibrate your Fluke equipment on a one-time basis. For customers who routinely service their own instruments, this service offers an easy way to smooth out your peak work loads. For others, it's an easy and economical way to take advantage of Fluke's extensive service capabilities.

The Standard Price Service Program sets a fixed charge for calibration and/or repair for each type of instrument. The calibration and/or repair price includes all labor and most materials required.

These standard prices, which are based on historical time and material averages, help you determine service costs in advance. They also obviate potentially critical delays caused by quotation and approval procedures. Of course, some units may fall outside the scope of the program because of age or abuse. In such cases you will be advised and, only with your approval, charged on the basis of the actual labor and parts required.

Please contact your nearest Fluke Service Center for local availability and terms of this service.

### Standard Price Calibration

Routine calibration ensures your instrument is performing to published specifications. Every instrument calibration follows the procedures detailed in our maintenance and service manuals. Instruments are returned with a Certificate of Calibration, your proof of traceability to international standards. We also include calibration labels which indicate the date of calibration plus seals to protect the integrity of the calibration performed.

Please contact your nearest Fluke Service Center for local availability and terms of this service.

### Standard Price Repair Plus Calibration

This is a cost-effective way to service your Fluke instruments on a one-off basis. Using the industry's finest test equipment, our factory-trained technicians will test all function and ranges while making the necessary repairs. We replace any defective parts with Fluke specified and tested parts to ensure the repaired instrument performs to published specifications.

During repair, we will also install product changes that enhance the instrument performance and reliability. It is subsequently calibrated in the same way as in the Standard Price Calibration service, inclusive of the same certification, labels and seals. Each unit is completely performance tested and returned with a service report.

Please contact your nearest Fluke Service Center for local availability and terms of this service.

## Replacement Parts

- Components meeting Fluke original equipment standards
- Automatic notice of improved replacement types
- 90-day warranty
- Recommended spare parts and module kits

Availability of replacement parts is a key element in providing quick turnaround and product support for customers who perform their own maintenance. By providing quality parts and responsive support, Customer Support Services will help return your Fluke products to peak performance.

To support this service, an extensive inventory of repair parts is maintained by our Replacement Parts Centers. These computerized centers stock several hundred thousand components, subassemblies, and modules. All replacement parts are warranted against defects in materials and workmanship for 90 days after shipment.

Place your orders with your nearest Fluke representative or Fluke Service Center. They will expedite processing or fill your order from the local inventory.

When ordering, please identify parts by the Fluke 6 or 12-digit part number and description as shown in the instrument manual and, if possible, by the schematic diagram circuit reference number. The model number and serial number will also help us supply the correct parts.

In some cases parts must be ordered in matched sets in order to maintain the specified accuracy and performance of the instrument after repair. Check the listings and diagrams for footnotes which contain the instructions for ordering special parts.

Recommended Spare Parts Lists and instrument manuals are also available for many Fluke products.

Many Fluke instruments are modular in design and can be serviced most effectively by exchanging a defective module. Fluke has a Module Exchange Program that allows you to order a replacement module in exchange for your defective module.

Please contact your nearest Fluke Sales or Service location for local availability and terms of this service.

## Extended Warranty Service

- Fixed maintenance costs allow accurate yearly budgeting
- Prioritized service
- Shorter repair cycle
- Reduced parts inventory
- Lower maintenance training costs
- Less demand on your technical personnel and resources

The Fluke Extended Warranty Plan provides ultimate equipment protection at an economical price. Comprehensive agreements provide routine calibration at regular intervals or repair service as needed. You can, of course, combine these options for full service coverage.

### Extended Warranty Repair Plan

This plan is an extension to your product warranty. Whenever your product needs repair or service, simply send it to the nearest Fluke Service Center. It will be repaired, recalibrated, and performance tested — with priority scheduling. All parts and labor are included in the price of this service, even parts that are normally excluded from the Standard Price Service plan. So there won't be any surprises, even return freight costs are included. As you might expect, a Fluke Service Report and Certificate of Calibration is enclosed with each repaired instrument. Contact your nearest Fluke Service Center for availability and complete terms of the extended warranty.

### Full Service Extended Warranty

If you need both scheduled calibration and periodic repair service, there is no better maintenance program for your equipment than our full service plan. It combines all the features of the Extended Warranty Repair into a single integrated full service plan. You pay a reasonable fee for each instrument and eliminate most additional service expenses.

Please contact your nearest Fluke Service Center for local availability and terms of this service.

### Pre-Plan Inspections

Sometimes an instrument inspection is required before we can offer an Extended Warranty plan. This usually occurs when an instrument's warranty has expired. Should the condition of the equipment preclude coverage we will provide a Labor and Materials Service quote for the repairs necessary to qualify your instrument.

# Customer Support Services

## Support Services

### Support Services for Discontinued Products

The Fluke Corporation recognizes the importance of continued support services for discontinued products. Providing support services is an important element to ensure that Fluke products meet customer's expectations during the active life of the product.

Our policy is to provide support services for a specified minimum period of time after a product has been discontinued from production. Support periods for most Fluke products are classified into one of three groups.

| Group | Description | Period |
|---|---|---|
| I | Most handheld service tools and higher cost accessories. | 4 years |
| II | General Purpose instrumentation. | 7 years |
| III | Lower cost accessories. The support period is the standard warranty period. | 1 year |

Contact any Fluke Service Center or your Fluke Sales Representative for the support period applicable to specific model numbers.

These support services are the same as during the active life of the product. During this support period Fluke will retain sufficient technical expertise and resources to ensure availability of replacement parts, exchange, and calibration/repair services. This support is available both on a one-time or per-incident basis, as well as under a service agreement program.

The useful life of a product may often be extended beyond these periods. For those products, Fluke can offer limited support as follows:

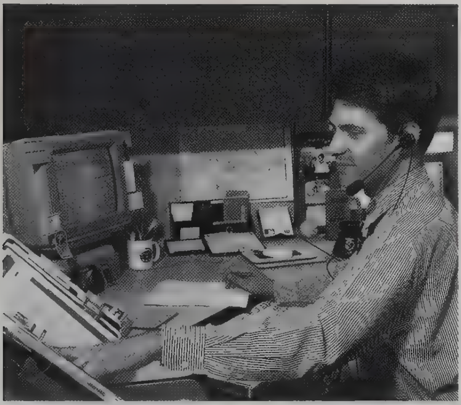
| Group | Period |
|---|---|
| I | 4 through 6 years after product phase-out |
| II | 7 through 10 years after product phase-out |
| III | Not applicable |

Extended support can be provided as long as demand and availability of parts allow us to deliver effective service and customer value. Extended support is subject to availability of replacement parts at a reasonable cost, trained and/or qualified personnel to perform the service, and equipment to repair and/or calibrate the specific model involved.

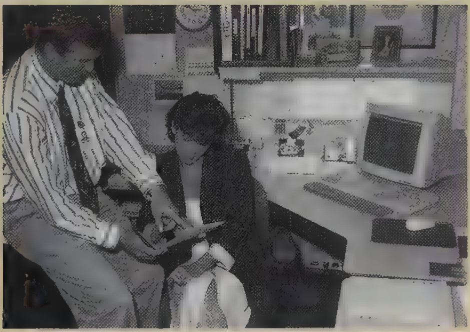
Most maintenance services for extended support is performed under time and material provisions. Repair turnaround times are typically longer than normal due to longer procurement and delivery times of replacement parts. Repair costs are typically higher than normal, due to lower volumes, higher parts costs, or special re-training or skills requirements. Service may only be available at selected service centers with specialized equipment or trained personnel.

# Working with Fluke

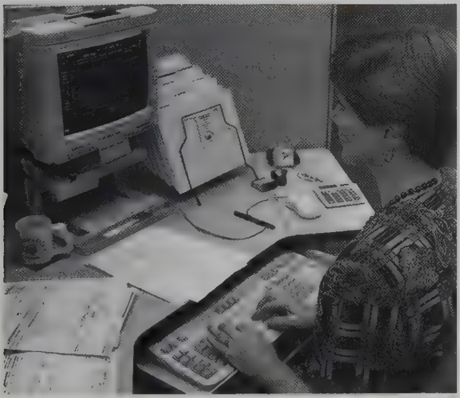
Ordering Fluke products is as easy and convenient as picking up the phone. Fluke Sales Offices, Representatives and Authorized Industrial Distributors are located worldwide to provide you with immediate sales assistance, on your local level. For details from delivery and terms, to technical information regarding the suitability of a particular product for a specific application, give us a call.



Sales Support



Purchasing



Order Processing

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Fluke's sales and service organization is built around one single promise: To give you, our customer, an extra measure of value in everything we do for you. The large number of convenient Fluke sales offices, technical service centers, distributors and representatives around the world is a reflection of that commitment. You can depend on them for quick, professional assistance regarding applications, specifications, pricing, availability, quotations, and shipping methods. See the Call Guide on the inside back cover of this catalog for instant reference on information and assistance on specific areas of interest.

## Fluke and Philips Warranties

Fluke and Philips products are covered by limited warranties. Full warranty details are included with each product shipped from the factory.

## Product Changes

Although product information and illustrations in this catalog were current at the time it was approved for printing, Fluke Corporation in a continuing effort to offer excellent products at a fair value, reserves the right to change specifications, designs, and models without notice.

## Calibration Documentation

These levels of calibration documentation are available for instruments shipped from the factory:

**1. Statement of Calibration Practices**

For every serialized, non-distributor Fluke product, Fluke automatically provides a **Statement of Calibration Practices** free of charge. This document states that the instrument was calibrated with standards that are traceable to the National Institute of Standards and Technology (NIST) in accordance with the requirements of MIL-STD-45662A.

Upon request at the time of order, a Statement of Calibration Practices can be provided for distributor products. Statements of Calibration Practices are supplied automatically and free of charge for most Philips products, too.

**2. Certificate of Calibration (Traceable to NIST)**

At the customer's request, traceability to NIST for an individual instrument can be established at the factory. As evidence of traceability, a MIL-STD-45662A **Report of Calibration**, a calibration label indicating date of calibration, a calibration seal to prevent tampering and a printout of outgoing readings are provided. These items are provided free of charge or model numbers 5700A, 5725A, 742A-xK, 792A, 732B with 000 or 100 option and 5790A. For all other serialized, non-distributor products, including Philips, the fee is 90% of the CSS one-time standard calibration price.

If a customer decides after receipt of the product that a Certificate of Calibration is needed, the product must be returned to the factory or a local service lab for traceability to be established. The charge is the one-time standard calibration price. There is an additional charge for a printout of the test data in these cases.

## Power Cords

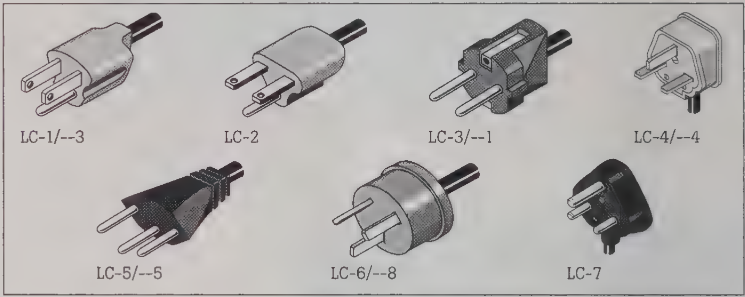
Fluke and Philips instruments are fitted with one of the power cord and plug options shown below and are wired for the voltage indicated. The power cord supplied with your instrument is the one commonly used in the country where the instrument will be delivered.

If you require a power cord and plug other than the one listed below for the country where the instrument will be delivered, specify that power cord and plug when you order.

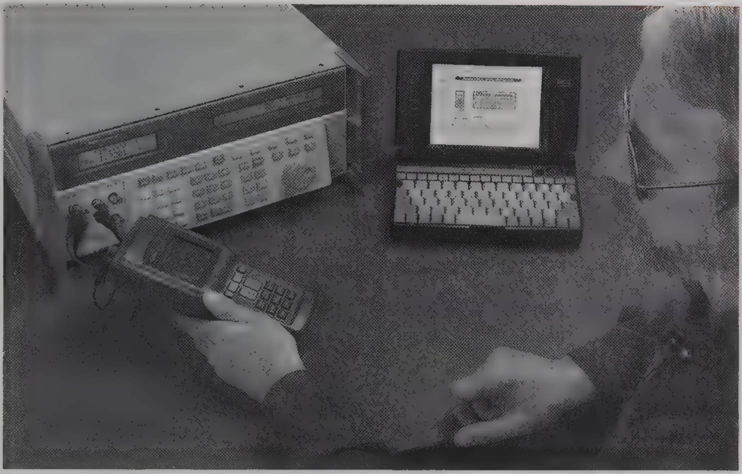
| | | | Philips | |
|---|---|---|---|---|
| | | Fluke | Product Category 1* | Product Category 2* |
| North America | 120V/15A | Option LC-1 | /--3 | Specify Country of destination on order |
| North American | 240V/15A | Option LC-2 | | |
| Universal Euro | 220V/16A | Option LC-3 | /--1 | |
| United Kingdom | 240V/13A | Option LC-4 | /--4 | |
| Switzerland | 220V/10A | Option LC-5 | /--5 | |
| Australia | 240V/10A | Option LC-6 | /--8 | |
| South African | 240V/5A | Option LC-7 | Ask for LC-7 | |

* Final digit in model number format PM----/--- for Philips Category 1 Product including Oscilloscopes, Multimeters, Recorders, and Logic Analyzers

** Philips Category 2 Products including Logic Analyzers, Signal Sources, Pulse Generators, Pattern Generators, and Counters



# Education Support Programs



## Education Programs

Educational institutions face a tremendous challenge training tomorrow's technicians, engineers, and scientists. The explosive growth in technology together with the pervasive electronic inroads into all aspects of our culture make the perennial budgetary constraints of education a daunting problem. The educator's job of defining an electronic curriculum, choosing the right equipment and keeping that equipment in good working order, a daunting task.

For many years Fluke has been working with educators in facing this important obligation. Fluke has focused on providing tools that allow the user to concentrate on the job at hand, not how to operate the tools or interpret results.

Fluke's Educational Support Programs are centered around a broad array of rugged, high performance instruments, a worldwide network of service and support, a series of comprehensive training materials, all at competititve prices.

## Ease of Operation

It is our mission to be the leader in compact, professional test tools. Since our users range from the first-time technical trainee to the highly skilled professional, Fluke is continually producing more sophisticated instruments with simpler, intuitive user interfaces. This means that valuable classroom time will not be spent on how to use Fluke equipment, and can be focused on the training material and the lesson.

## Product Reliability

Fluke instruments are designed and built to take the toughest abuse. Our equipment is able to withstand any physical or electrical misuse they might encounter in your teaching laboratories or at a remote field site. Most of Fluke instruments meet or exceed the safety specifications outlined by UL, CSA and the European VDE. And our MTTF (Mean Time To Failure) specs attest to our rigorous design and Quality Control standards. In support of these claims for reliability, all of our instruments are backed by one-, two- or three-year warranties.

## Product Breadth

Today's electronic education ranges from basic electrical theory to advanced electronics research. Fluke offers a broad array of instrumentation to meet these classroom and laboratory needs, all offering exceptional value. Fluke equipment's reliable performance consistently provided ingenious students the platform for experimenting successfully in unexpected and innovative new ways.

Our products include real-time (analog) and storge oscilloscopes (analog and digital), handheld and bench digital multimeters, frequency counters and counter/timers, function generators, component testers (RCL Meters), data acquisition equipment, LANMeter and ScopeMeter Test Tools, Process Calibrators, Harmonics Analyzers, and Graphical MultiMeters.

Of particular interest to those educators moving their students from the analog into the digital world are our oscilloscopes and DMMs that combine both analog and digital capability. Using both measurement modes, one gains a strong understanding for the vital aspects of the growing digital domain. Our CombiScopes feature fully automatic autoranging, which has become the industry standard.

Today's electronic world requires that instruments and computers share data readily. Fluke has long supported laboratory standards such as BPIB/IEEE-488 and RS-232C. Many of our newer products either perform diagnostics upon, or transfer data over standard Local Area Network (LAN) links.

The LAN diagnostic tools can be used for either detailed analysis and verification of lab exercises, for training aids in explaining the basic operation of common network topologies and protocols, or for maintaining campus LAN and WAN infrastructures. The detailed supporting information provided in operator manuals and other related documentation and training material can itself form the foundation for a series of courses.

Fluke's line of portable, networked and wireless data acquisition equipment offer educators and students the ability to record and analyze multiple parameters so often required in lab and field studies. Fluke's Windows based data acquisition software is easy to use and allows you to collect and display and analyze data in a variety of ways. Our data acquisition products provide the measurement accuracy you expect and the software analysis tools you need to provide meaningful experiences for your students.

Whether your curriculum covers basic electronics or cutting edge Internet networking, your Fluke sales engineer can work with you, defining the equipment that best meets your needs.

## Worldwide Support

When you choose a test equipment vendor, the product is just the first step. Fluke understands that selecting a vendor who backs that product with capable technical assistance and reliable, rapid and affordable service is a critical issue in your decision. Fluke ranks "number 3" in sales of test instumentation worldwide. That makes us large enough to have a network of service and support facilities to fully serve our customers yet small enough to give that "extra measure" of customer care long after the sale is concluded. For over 40 years we have lived by the motto that we "... give the Customer a little bit more than he thought he paid for." Every day, all of us at Fluke work hard to ensure this motto gets translated into true customer satisfaction.

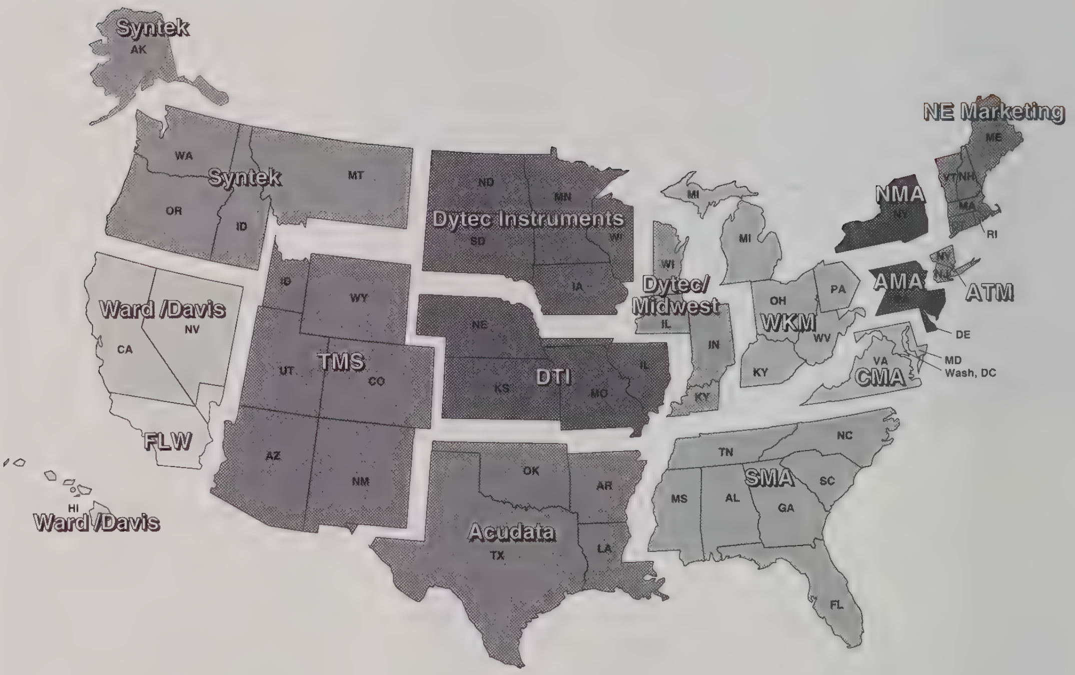
## Exceptional Value

The Fluke company has built its reputation by serving customers with products of exceptional value – high performance, proven reliability and fair prices. Nowhere is this more important than in educational institutions. In the U.S., we also support the teaching community with a series of Educational Discounts, Gifting Programs, and Extended Product Support plans designed specifically for education.

**To see how we can effectively address YOUR teaching needs, contact your local Fluke Sales Office or representative.**

# Sales and Service Locations

## U.S. Sales Offices & Service Facilities


Syntek
AK
WA
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MT
OR
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Ward /Davis
NV
CA
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Ward/Davis
ID
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UT
TMS
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Dytec Instruments
SD
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DE
NE Marketing
ME
VT
NH
MA
RI
NMA
NY
AMA
NJ
ATM
TN
NC
SMA
SC
MS
AL
GA
FL

### Worldwide Sales Headquarters

**Mailing Address**
P.O. Box 9090
Everett, WA 98206-9090

**Street Address**
6920 Seaway Blvd.
Everett, WA 98203

**Shipping Address**
9028 Evergreen Way
Everett, WA 98204

**Fax Numbers**
(206) 356-5116
(206) 356-5174
*Please note department to which you wish fax to be directed.*

**Main Switchboard**
(206) 347-6100

**For Immediate Assistance**
Call Toll Free
1-800-44-FLUKE

### U.S. Sales Offices

**Acudata, Inc.**
110 Cypress Station Drive, Suite 108
Houston, TX 77090
Tel: (713) 580-2451
Fax: (713) 580-6421

720 Ave. F., Suite 104
Plano, TX 75074
Tel: (214) 424-3567
Fax: (214) 422-7342

801 Ranch Road 620 S., Suite 200
Austin, TX 78734
Tel: (512) 263-1500
Fax: (512) 263-1637

6216 South Lewis, Suite 103
Tulsa, OK 74136
Tel: (918) 743-1875
Fax: (918) 743-1892

13423 Blanco Road #309
San Antonio, TX 87216
Tel: (210) 492-9891
Fax: (210) 492-5396

**Atlantic Marketing Associates**
1455 Valley Road
Wayne, NJ 07470
Tel: (201) 633-7070
Fax: (201) 633-7787

905 Judie Lane
Ambler, PA 19002
Tel: (215) 646-1797
Fax: (215) 643-6494

**Advanced Technical Marketing, Inc.**
1455 Valley Road
Wayne, NJ 07470
Tel: (201) 633-7070
Fax: (201) 633-7787

**Creative Marketing Associates, Ltd**
9140-H Guilford Road
Columbia, MD 21046
Tel: (301) 953-7740
Fax: (301) 725-5088

**Dynamic Technology, Inc.**
373 Collins Road NE, Suite 22A
Cedar Rapids, IA 52402
Tel: (319) 378-8558
Fax: (319) 378-8557

2271 Administration Drive
St. Louis, MO 63146
Tel: (314) 567-1984
Fax: (314) 567-0755

2007 Prairie Circle, Suite C
Olathe, KS 66062
Tel: (913) 780-4444
Fax: (913) 780-2992

1427 W. Douglas
Wichita, KS 67213
Tel: (316) 263-7090
Fax: (316) 262-3189

**Dytec Instruments, Inc.**
10740 Lyndale Ave. S
Bloomington, MN 55420
Tel: (612) 831-7169
Fax: (612) 884-6336

**Dytec/Midwest, Inc.**
3385 K North Arlington Heights Road
Arlington Heights, IL 60004
Tel: (708) 255-3200
Fax: (708) 255-4874

139 E. Capitol, Suite 6
Hartland, WI 53029
Tel: (414) 367-4550
Fax: (414) 367-3319

7212 N. Shadeland Ave., Suite 230
Indianapolis, IN 46250
Tel: (317) 849-9898
Fax: (317) 841-9060

**FLW**
3505 Cadillac Ave., Bldg. E
Costa Mesa, CA 92626
Tel: (714) 751-7512
Fax: (714) 751-0213

**Northeast Marketing Associates, Inc.**
Old Boston Street Office Park
462 Boston Street, Suite 3, Floor 2
Topsfield, MA 01983
Tel: (508) 887-5110
Fax: (508) 887-5540

**Northern Marketing Associates**
1455 Valley Road
Wayne, NJ 07470
Tel: (201) 633-7070
Fax: (201) 633-7787

55 Wheatstone Circle
Fairport, NY 14450
Tel: (716) 388-1067
Fax: (716) 377-7727

3528 Westlake Road
Canandaigua, NY 14424
Tel: (716) 394-5560
Fax: (716) 394-8053

**Southern Marketing Associates, Inc.**
2180 State Road 434, Suite 1124
Longwood, FL 32779
Tel: (407) 682-7317
Fax: (407) 682-7443

2760 Elm Drive N.E.
Palm Bay, FL 32905
Tel: (407) 951-7559
Fax: (407) 951-7379

3801 Triana Blvd. Suite 9
Huntsville, AL 35805
Tel: (205) 881-6035
Fax: (205) 881-6031

1950 Redd Road
Alpharetta, GA 30201
Tel: (770) 664-9797
Fax: (770) 664-9795

5943 Farmgate Road
Raleigh, NC 27606
Tel: (919) 233-1644
Fax: (919) 233-4611

1080 Carroll Street
Dudley, GA 31022
Tel: (912) 676-4333
Fax: (912) 676-3078

**Syntek**
1407 116th Ave. N.E., Suite 117
Bellevue, WA 98004
Tel: (206) 462-7700
Fax: (206) 462-7170

9450 SW Commerce Circle, Suite 312
Wilsonville, OR 97070
Tel: (503) 682-2750
Fax: (503) 682-9180

N. 17826 West Shore Road
Nine Mile Falls, WA 99026
Tel: (509) 466-0451
Fax: (509) 468-7648

**Technical Marketing Specialists**
725 S. Broadway, Suite 11
Denver, CO 80209
Tel: (303) 744-0882
Fax: (303) 744-0851

1338 Foothill Drive, #319
Salt Lake City, UT 84108
Tel: (801) 647-9872
Fax: (801) 649-4023

1930 W. Peoria, Suite 305
Phoenix, AZ 85029
Tel: (602) 678-4940
Fax: (602) 678-4943

3232 San Mateo, NE #98
Albuquerque, NM 87110
Tel: (505) 897-9355
Fax: (505) 899-1108

**Ward/Davis Associates**
2623 Manhattan Beach Blvd.
Redondo Beach, CA 90278-1604
Tel: (310) 643-6977
Fax: (310) 643-6035

3329 Kifer Road
Santa Clara, CA 95051-0753
Tel: (408) 245-3700
Fax: (408) 738-3995

**WKM Associates, Inc.**
733 Congress Park Drive
Dayton, OH 45459
Tel: (513) 434-7500
Fax: (513) 434-6590

8052B State Street
Garrettsville, OH 44231
Tel: (216) 527-7301
Fax: (216) 527-7305

15110 Foltz Industrial Parkway,
Suite 106
Strongsville, OH 44136
Tel: (216) 572-8338
Fax: (216) 572-8180

12300 Perry Highway
Wexford, PA 15090
Tel: (412) 934-2730
Fax: (412) 934-2761

7002 N Graham Road, Suite 226
Indianapolis, IN 46220
Tel: (317) 594-0301
Fax: (513) 434-6590

1209 Chicago Road
Troy, MI 48083-4231
Tel: (810) 588-2300
Fax: (810) 588-9332

## U.S. Service Facilities

**Fluke Service Center**
P.O. Box 9090
1420 75th Street SW
Everett, WA 98203-9090
Tel: (206) 356-5560

**Fluke Service Center**
46610 Landing Parkway
Fremont, CA 94538
Tel: (510) 651-5112
Fax: (510) 651-5665

**Fluke Calibration Center**
3505 Cadillac Ave
Bldg E
Costa Mesa, CA 92626
Tel: (714) 863-9031
Fax: (714) 757-7556

**Fluke Service Center**
1150W Euclid Avenue
Palatine, IL 60067
Tel: (708) 705-0500
Fax: (708) 705-9989

**Fluke Service Center**
West 75 Century Road
Paramus, NJ 07652-0930
Tel: (201) 599-9500
Fax: (201) 599-2093

FLUKE.

# Sales and Service Locations

## International Sales/Service Offices

**Fluke Service Center**
2104 Hutton Drive, Suite 112
Carrollton, TX 75006
Tel: (214) 406-1000
Fax: (214) 406-1072

## International Sales Offices

**Antilles**
**Philips Antillana N.V.***
Kaminda A.J.E. Kusters nr 4
P.O. Box 3523/3051
Willemstad, Curacao
Netherland Antilles
Tel: (599) 9-615277
Fax: (599) 9-612772

**Argentina**
**Coasin, S.A.** †**
Virrey del Pino 4071
1430 Capital Federal
Buenos Aires, Argentina
Tel: (54) 1-522-5248
Fax: (54) 1-555-3321

**Viditec S.A.*** †**
Lacarra 234
Buenos Aires CP 1407
Argentina
Tel: (54) 1-636-1200
Fax: (54) 1-636-2185

**Australia**
**Philips Scientific &**
**Industrial Pty. Ltd.* †**
T&M Division
34 Waterloo Rd.
North Ryde, N.S.W. 2113
Australia
Tel: (61) 2-888-0416
Fax: (61) 2-888-0440

**Austria**
**Fluke Vertriebs GmbH* †**
Südrandstrasse 7
P.O. Box 10
A-1232 Vienna
Austria
Tel: (43) 1.61410-0
Fax: (43) 1.61410-10

**Bahrain**
**Mohammed Fakhroo & Bros.**
P.O. Box 439
BAHRAIN
Tel: 973 253529
Fax: 973 275996

**Bangladesh**
**Motherland Corporation***
4 Hatkhola Road, (1st Floor)
(Tikatuli) Dhaka - 1203
Bangladesh
Tel: (880) 2-233240
Fax: (880) 2-833983

**Belgium**
**N.V. Fluke Belgium S.A.* †**
Langeveldpark - Unit 5 & 7
P. Basteleusstraat 2-4-6
1600 St. Pieters-Leeuw
Belgium
Tel: (32) 02.33 12 777
Fax. (32) 02.33 11 489

**Bolivia**
**Coasin Bolivia S.R.L.* †**
Casilla 7295
Calle Ayacucho No. 208
Edificio Flores, 5to. Piso
La Paz, Bolivia
Tel: (591) 2-317531
Fax: (591) 2-317545

**Brazil**
**Philips Medical Systems LTDA.* †**
Div. Industrial Electronics
Av. Interlagos. N. 3493 - Campo Grande
04661-220 Sao Paulo S.P.
Brazil
Tel: (55) 11-523 4811
Fax: (55) 11-524 4873

**Bulgaria**
**Sophilco**
P.O. Box 42
1309 SOFIA
Tel: 359 2 200785
Fax: 359 2 220910

**Canada**
**Fluke Electronics Canada Inc.* †**
400 Brittania Road
East Unit #1
Mississauga, Ontario
L4Z 1X9, Canada
Tel: (905) 890-7600
Fax. (905) 890-6866

**Fluke Electronics Canada Inc.***
101, 1144 - 29th Avenue N.E.
Calgary, Alberta
T2E 7P1, Canada
Tel: (403) 291-5215
Fax: (403) 291-5219

**Fluke Electronics Canada Inc.***
1255 Trans Canada Highway
Suite 120
Dorval, Quebec
H9P 2V4, Canada
Tel: (514) 685-0022
Fax: (514) 685-0039

**Chile**
**Intronica* †**
Instrumentacion Electronica,
S.A.C.I.
Guardia Vieja 181 Of. 503
Casilla 16500
Santiago 9, Chile
Tel: (56) 2-232-3888
Fax: (56) 2-231-6700

**China, Peoples Republic of**
**Fluke International Corporation* †**
Fluke Representative Office
Room 2112, Scite Tower
Jianguomenwai Dajie
Beijing 100004, PRC
Tel: (86) 1-512-3435
Fax: (86) 1-512-3437

**Fluke International Corporation***
Shanghai Representative Office
No. 301, Hua Shan Road
Room 405
Shanghai 200040, PRC
Tel: (86) 21-248-8999
Fax: (86) 21-248-3789

**C.I.S.**
**Infomedia**
Ul. Petrovsko-Razumovsky proezd. 29
103287 MOSCOW
Tel: 7 095 2123833
Fax: 7 095 2123838
Telex: 411670 dnepr su

**Colombia**
**Sistemas E Instrumentacion,**
**Ltda. (S.E.I.)* †**
Carrera 21, No. 39A-21, Of. 101
Ap. Aereo 29583
Bogota, Colombia
Tel: (57) 1-287-5424
Fax: (57) 1-287-2248

**Costa Rica**
**Electronic Engineering, S.A.** †**
Carretera de Circunvalacion
Savanilla Av. Novena
San Jose, Costa Rica
Tel: (506) 253-3759
Fax: (506) 225-1286

**Croatia**
**KALTIM- ZAGREB**
Draga 8
41425 SVETA JANA
Tel: 38 5 1 837115
Fax: 38 5 1 837237

**Czech Republic (also for**
**Slovak Republic)**
**ELSO**
Na Berance 2
16200 PRAHA 6
Tel: 42 2 3164810
Fax: 42 2 364986

* For Complete Fluke Product Line
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† Authorized Service Center

# Sales and Service Locations

## International Sales/Service Offices

**ELSO TRENCIN**
Str. Stafanikova 20
911 01 TRENCIN
Tel: 42 831 31410
Fax: 42 831 31592

**Cyprus**
**D. Ouzounian, M. Soultanian & Co.**
P.O. Box 1775
NICOSIA
Tel: 357 2 442220
Fax: 357 2 459885

**Denmark**
**Fluke Danmark A/S* †**
Ejby Industrivej 40
DK-2600 Glostrup
Denmark
Tel: (45) 43 44 1900
Fax: (45) 43 43 9192

**Ecuador**
**Proteco Coasin Cia., Ltda.** †**
Av. 12 de Octubre 2449 y Orellana
P.O. Box 17-03-228-A
Quito, Ecuador
Tel: (593) 2-230283
Fax: (593) 2-561980

**Egypt**
**EEMCO**
Electronic Equipment Marketing Co.
9. Hassan Mazher St.
P.O. Box 2009
Heliopolis 11361
Tel: 20 2 4178296
Fax: 20 2 4178296

**Fiji**
**Communications Pacific, Ltd.***
22 Disraeli Road
Suva, Fiji
Tel: (679) 312744
Fax: (679) 300379

**Finland**
**Fluke Finland Oy* †**
Sinikalliontie 3
PL 151
SF-02631 Espoo
Finland
Tel: (358) 90 615 25600
Fax: (358) 90 615 25630

**France**
**Fluke France S.A.* †**
37, Rue Voltaire
BP 112
93700 Drancy
France
Tel: (33) 1 48 96 63 00
Fax: (33) 1 48 96 63 50

**Germany**
**Fluke Deutschland GmbH***
Heinrich-Hertz-Strasse 11
34123 Kassel
Germany
Tel: (49) 0561 9594 0
Fax: (49) 0561 9594 119

**Great Britian**
See United Kingdom

**Greece**
**Philips S.A. Hellenique**
P.O. Box 3153
15, 25th March Street
177 78 TAVROS/ATHENS
Tel: 30 1 4894911
Fax: 30 1 4818594/4894434

**Hong Kong**
**Schmidt Electronics***
18th Floor, Great Eagle Centre
23 Harbour Road
Wanchai, Hong Kong
Tel: (852) 2507-0222
Fax: (852) 2827-5656

**Schmidt & Co., Ltd.**
Service Center
1st Floor
323 Jaffe Road
Wanchai, Hong Kong

**Hungary**
**MTA-MMSZ kft.**
Etele ut. 59-61
P.O. Box 58
H-1502 BUDAPEST
Tel: 36 1 1662366
Fax: 36 1 1611021

**Iceland**
**TAEKNIVAL hf**
P.O. Box 8294
Skeifunni 17
128 REYKJAVIK
Tel: 354 1 681665
Fax: 354 1 680664

**India**
**Hinditron Services Pvt., Ltd.****
204-206 Hemkunt Tower
98 Nehru Place
New Dehi 110 019, India
Tel: (91) 11-643-0519
Fax: (91) 11-642-29118

**Philips India Ltd.*****
Hindustan Times House
18/20 Kasturba Gandhi Marg
New Delhi 110001, India
Tel: (91) 11-331-8370
Fax: (91) 11-331-6839

**Indonesia**
**P.T. Daeng Brothers* †**
Philips House
J/n. H.R. Rasuna Said Kav. 3-4
Jakarta 12950, Indonesia
Tel: (62) 21-520-1122
Fax: (62) 21-520-5189

**Israel**
**R.D.T. Equipment & Systems* †**
(1993) LTD.
P.O. Box 58072
Tel Aviv 61580, Israel
Tel: (972) 3-645-0745
Fax: (972) 3-647-8908

**Italy**
**Fluke Italia S.r.l.* †**
Viale delle Industrie, 11
20090 Vimodrone (MI)
Italy
Tel: (39) 02.268 434.1
Fax: (39) 02.250 1645

**Japan**
**Fluke Corporation* †**
Sumitomo Higashi Shinbashi Bldg.
1-1-11 Hamamatsucho
Minato-ku, Tokyo 105
Japan
Tel: (81) 3-3434-0181
Fax: (81) 3-3434-0170

**Jordan**
**Jordan Medical Supplies and Services**
P.O. Box 140415
AMMAN
Tel: 962 6 699353/4/5/6
Fax: 962 6 663556

**Korea**
**B&P International Co., Ltd.* †**
Geopyung Town A-303
203-1 Nonhyun-dong Kangnam-ku
Seoul 135-010, Korea
Tel: (82) 2-546-1457
Fax: (82) 2-546-1458

**Low Cost Distribution Products**
Il Myoung Inc. †
780-46, Yeogsam-Dong
Kangram-Ku
Seoul, Korea
Tel: (82) 2-552-8582
Fax: (82) 2-553-0388

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† Authorized Service Center

# Sales and Service Locations

## International Sales/Service Offices

**Kuwait**
**Yusuf A. Alghanim & Sons W.L.L.**
P.O. Box 223 SAFAT
Alghanim Industries Airport Rd Shuwaikh
13003 KUWAIT
Tel: 965 4842988 ext. 2304
Fax: 965 4847244/4846819

**Lebanon**
**Electronic Supplies S.A.R.L.**
Autostrada Dora, Kassargian Bldg.
P.O. Box 90
1388 BEYROUTH
Tel: 961 1 884271/894243
Fax: 961 1 898842

**Macedonia**
**AD TEHNOKOM**
Gradski Trgovski Centar 3 Sprat
91000 SKOPJE
Tel: 389 91 115780
Fax: 389 91 225353

**Malaysia**
**CNN SDN. BHD.* †**
17D, 2nd Floor
Lebuhraya Batu Lancang
Taman Seri Damai
11600 Jelutong Penang
Malaysia
Tel: (60) 4-657-9584
Fax: (60) 4-657-0835

For LAN & Distribution Products,
contact: **Fluke Singapore**

**Malta**
**CAM Services Ltd. "CAM CENTRE"**
Triq 1-Industrija
QORMI QRM 09
Tel: 356 484640/484650
Fax: 356 447174

**Mexico**
**Mexicana de Electronica* †**
**Industrial, S.A. (MEXEL)**
Diagonal No. 27 - 3° Piso
Colnia del Valle
C.P. 03100, Mexico DF
Tel: (52) 5-682-8040
Fax: (52) 5-687-8695

**Nepal**
**Associated Enterprises***
G.P.O. Box No. 790
Ga 3-30 Pyaphal Tole
Kathmandu-3, Nepal
Tel: (977) 1-213868
Fax: (977) 1-221744

**Netherlands**
**Fluke Nederland B.V.***
Postbus 1337
5602 BH Eindhoven
The Netherlands
Tel: (31) 040.644 100
Fax: (31) 040.644.111

**New Zealand**
**Philips Scientific**
**& Industrial (Pty) Ltd.* †**
Test & Measurement Division
Private Bag 41904
St. Lukes, & Wagener Place
Mt. Albert, Auckland 3
New Zealand
Tel: (64) 9-849-4160
Fax: (64) 9-849-7814

**Norway**
**Fluke Norge A/S* †**
Ole Deviks vei 2
P.O. Box 6054 Etterstad
N-0601 Oslo
Norway
Tel: (47) 22.65 34 00
Fax: (47) 22.65 34 07

**Oman**
**Mustafa & Jawad Science**
**and Industry Co.**
P.O. Box 1918 RUWI
Postal Code 112
Sult. of Oman
Tel: 968 602009
Fax: 968 607066/697200/564005

**Peru**
**Importaciones y Representaciones**
**Electronicas S.A. (I.R.E.)** †**
Jr. Pumacahua 955
Lima 11, Peru
Tel: (51) 14 23-5099
Fax: (51) 14 31-0707

**Philippines, Republic of**
**Spark Electronics Corp.* †**
P.O. Box 610 Greenhills
Metro Manila 1502
Philippines
Tel: (63) 2-700621
Fax: (63) 2 721-0491

**Poland**
**Electronic Instrument Service (E.I.S.)**
Ul. Malechowska 6
60-188 POZNAN
Tel: 48 61 681998
Fax: 48 61 682256

**Portugal**
**Fluke Ibérica S.L.* †**
Campo Grande, 35-7°B
1700 Lisboa
Portugal
Tel: (351) 1.795 17 12
Fax: (351)1.795.17.13

**Qatar**
**Darwish Trading Co.**
P.O. Box 92
DOHA
Tel: 974 434308
Fax: 974 417599

**Romania**
**RONEXPRIM S.R.L.**
Str. Transilvaniei nr. 24
70778 BUCHAREST - I
Tel: 40 1 6143597/98/99
Fax: 40 1 6594468 / 4016136244

**Saudi Arabia**
**A. Rajab & Silsilah**
P.O. Box 203
21411 JEDDAH
Tel: 966 2 6610006
Fax: 966 2 6610558

**Singapore**
**Fluke Singapore Pte Ltd.* †**
#27-03 PSA Building
460 Alexandra Road
Singapore 0511
Tel: (65) 276-5161
Fax: (65) 276-5929

**Slovenia**
**ELACSS d.o.o.**
Medvedova 28
61000 Ljubljana
Tel: 386 61 317178
Fax: 386 61 301595

**South Africa**
**Spescom MeasureGraph* †**
**(Pty) Limited**
Spescom Park
Crn. Alexandra Road and
Second Street
Halfway House, Midrand 1685
South Africa
Tel: (27) 11-315-0757
Fax: (27) 11 805-1192

**Spain**
**Fluke Ibérica S.L.* †**
Centro Empresarial Euronova
C/Ronda de Poniente, 8
28760 Tres Cantos
Madrid
Tel: (34) 1.804.27.50
Fax: (34) 1.804.28.41

**Sri Lanka**
**Computerlink, Ltd.* †**
No. 248 Galle Road
Colombo 4
Sri Lanka
Tel: (94) 1 502111-5
Fax: (94) 1 502203

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† Authorized Service Center

# Sales and Service Locations

## International Sales/Service Offices

**Suriname**
**Surtel***
Grote Hofstraat 3
Paramaribo
Suriname
Tel: (597) 472118
Fax: (597) 452745

**Sweden**
**Fluke Sverige AB* †**
Box 61
Kronborgsgränd 11
S-164 94 Kista
Sweden
Tel: (46) 8.751 0230
Fax: (46) 8.751 0480

**Switzerland**
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Rütistrasse 28
CH-8952 Schlieren
Switzerland
Tel: (41) 01.730 33 10
Fax: (41) 01.730 37 20

**Taiwan**
**Schmidt Scientific Taiwan Ltd.* †**
5th Floor, No. 178, Sec. 2
Min Sheng E. Road
Taipel, Taiwan R.O.C.
Tel: (886) 2-501-3468
Fax: (886) 2-502-9692

**Thailand**
**Measuretronix Ltd.* †**
2102/31 Ramkamhang Road
Bangkok 10240,
Thailand
Tel: (66) 2-375-2733
Fax: (66) 2-374-9965

**Turkey**
**PESTAS Profesyonel Elektronik**
**Sistemler Tic. ve San. A.S.**
Selcuklar Caddesi, Meydan Apt. No. 49
Daire 23
Akatlar 80630 Istanbul
Tel: 90 212 2827838
Fax: 90 212 2830987

**U.A.E.**
**Haris Al Afaq (Abu Dhabi)**
(opp. to Japan Embassy, building no. 439)
P.O. Box 26386
ABU DHABI
Tel: 971 2 656181/655910
Fax: 971 2 652909

**Haris Al-Afaq Ltd.**
P.O. Box 8141
DUBAI
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Fax: 971 4 281285

**United Kingdom**
**Fluke (U.K.) Ltd.* †**
Colonial Way
Watford Herts WD2 4TT,
England
Tel: (44) 1923.240 511
Fax: (44) 1923.225 067

**Uruguay**
**Coasin Instrumentos S.A.****
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11200 Montevideo
Uruguay
Tel: (598) 2 492436
Fax: (598) 2 492199

**Coasin Uruguaya, S.A.**
Service Center
Casilla de Correo 1400
Libertad 2529
Montevideo
Uruguay

**U.S.A.**
**Fluke Corporation***
P.O. Box 9090
6929 Seaway Boulevard
Everett, WA 98206
Tel. (800) 443-5853
Fax. (206) 356-5116

**Venezuela**
**Coasin C.A.* †**
Calle 9 Con Calle 4,
Edif Edinurbi
PISO -3, La Urbina
Carcas 1070-A,
Venezuela
Tel: (58) 2 241-0309
Fax: (58) 2 241-1939

**Vietnam**
**Schmidt-Vietnam Co., Ltd.* †**
6/Fl. Pedagogical College Bldg.
KM 8 Highway 32, Dich Vong
Tu Liem - Hanoi
Vietnam
Tel: (84) 4-346 186
Fax: (84) 4-346 188

**For other countries not listed contact:**
**Fluke Europe B.V.**
Export Dept.
P.O. Box 1186
5602 BD Eindhoven
Tel. +31.40.644 200
Fax. +31.40.644 222

**All other countries**
**Fluke Corporation**
P.O. Box 9090
6929 Seaway Boulevard
Everett, WA 98206
Tel. +1 206 356-5500
Fax. +1 206 356-5116

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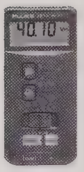
# Other Test Tools available from Fluke



### 10 Series Multimeters

The three Fluke 10 Series models are designed to support first level electrical and electronic troubleshooting. Their compact design, slide-switch and pushbutton controls allow true one-hand operation.

### 70 Series II Analog/ Digital Multimeters

Few handheld DMMs can match the Fluke 70 Series II for versatility and flexibility in a wide variety of applications. Suitable for measurements in protected circuits which do not exceed 4800 VA, the 70 Series provides a wealth of automatic features, measurement capabilities, and accuracy ranges.

### 21/23 Series II Analog/ Digital Multimeters

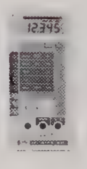
As industrial counterparts to Fluke's 70 Series II Multimeters, our Models 21 and 23 are equivalent in specification, features and functions to the Fluke 75 and 77. The bright yellow color of Fluke's 20 Series II Multimeters and high impact-resistant ABS case reflect their intended use for industrial electrical applications.

### 29/79 Series II Analog/ Digital Multimeters

Fluke's top-of-the-line Model 29 (yellow) and Model 79 (gray) Series II Multimeters are packed with comprehensive features and faster ranges, all in a compact handheld design. These meters place state of the art performance within the grasp of users who need greater accuracy and multiple functions.

### 25/27 Analog/Digital Multimeters

The Fluke 25 and 27 combine accurate digital and analog measurement capability with extreme ruggedness and durability. They are totally sealed, tough enough to withstand water, contaminants, chemicals, accidental drops and severe electrical overloads.



### 8060A/8062A 4.5-Digit Handheld DMMs

Fluke's 8060A and 8062A 20,000 count DMMs offer more measurement capabilities than many bench/portable models. Well suited for engineers and technicians working in audio, video, telecommunications, or computer technology, both meters combine precision and accuracy with a wealth of features to fit nearly every application.

### 80 Series Analog/ Digital Multimeters

Fluke's 80 Series 4000-count DMMs provide 11 functions for electronic and industrial applications, including high performance DC/AC voltage and current measurement, frequency, duty cycle, resistance, conductance, and capacitance measurement. All three meters are housed in a splash-proof, dust-proof case. A protective holster is included with each model.

### 45 Dual Display Multimeter

The Fluke 45 is a feature-rich 5-digit, 100,000 count meter that truly fits all applications and virtually any measurement need - on the workbench or in the field. Two multi-function displays and 16 different measurement capabilities allow wide ranging versatility at an affordable price.

The Fluke 45 delivers high performance and flexibility for manufacturing test, depot and field service, as well as R&D applications.

Need Technical Assistance?
Want to know your closest source to buy these products?
Call:

**1-800-44-FLUKE**

Toll-free in the U.S.
(905) 890-7600 in Canada

# Other Test Tools available from Fluke

### 51/52 Digital Thermometers

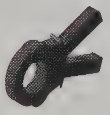
The Fluke 50 Series combines Fluke's technical expertise in low-cost handheld test instruments and laboratory-grade benchtop temperature instruments to create one of the most advanced, yet affordable, handheld thermometer lines in the industry. The Fluke 51 and 52 offer high accuracy, high performance and simple operation. Both work with K or J-type thermocouples.

### 30 Clamp Meter

The Fluke Model 30 Clamp Meter is a rugged, self contained, general purpose clamp meter that measures up to your tough standards at a basic price. Use the Model 30 to measure ac current, ac volts, ohms, and continuity for troubleshooting commercial and residential electrical and HVAC systems. You can view the results instantly on the easy-to-read digital display. Its tapered jaws allow easy access in crowded junction boxes and can accept cables up to 1-1/2" (38 mm) in diameter.

### 31/33 Current Master

The Fluke 31 and 33 Current Masters offer the combination of true-rms ac current measurements and rugged, reliable performance needed to troubleshoot problems associated with both traditional and non-linear loads.



### Accessories

To maximize functionality in specific test situations, Fluke offers a wide range of accessories. These include temperature modules and thermocouple probes, connecting leads, probes and adapters for simple test system hook up and products for convenient storage and carrying. Fluke test tool accessories are unsurpassed in quality of design and workmanship. They are also compatible with other manufacturers' test tools.

### 610 CableMapper

The new Fluke 610 CableMapper is designed to find all UTP termination faults at the touch of a button and detect split pairs — something no other wiremapper can do.

### 620 CableMeter

The new Fluke 620 CableMeter verifies the correct termination, connection and routing of LAN cabling. Utilizing a new technology, the 620 is the only tool that can test whether a connection has been properly implemented — without using a remote unit at the other end of the cable. This allows the installer to "test the connection as they go."

Need Technical Assistance?
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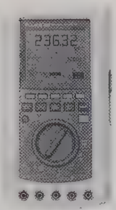
Call:

**1-800-44-FLUKE**

Toll-free in the U.S.
(905) 890-7600 in Canada



### 860 Series Graphical™ Multimeters

Graphical™ Multimeters represent a whole new category of test instruments that combine the industry's most advanced multimeter capabilities with the visual power of waveform display, in-circuit component testing, trend plotting and logic activity detection — all in one easy-to-use, handheld instrument.

Fluke's 860 Series is a family of three GMM test tools that are the first high-accuracy, high-performance multimeters combined with analog, digital and graphical displays.

Fluke's GMM test tools are multi-purpose, multi-functional tools designed for a wide variety of applications.

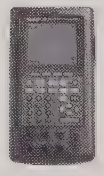
### ScopeMeter® Series II

The Fluke ScopeMeter® Series II is a fully integrated, battery powered, 50 MHz digital storage oscilloscope and a 3⅔-digit multimeter designed for measurements 'on-the-go'. This new test tool is easy to use with quick set-ups and hands-free operation. Designed with a sealed, ruggedized case, the ScopeMeter Series II performs reliably, even in wet, dusty or dirty environments. And the backlit screen makes for easy readings in bright light and low light situations.

# Other Test Tools available from Fluke

### 40/41 Power Harmonics Meters

For comprehensive power system troubleshooting, the Fluke 40 Power Harmonics Meter and model 41 Power Harmonics Analyzer track down problems before they become costly or harmful. Elusive problems — the cause of a hot transformer, overloaded neutral wire, vibrating electrical panel, or voltage and current distortion — become easy to diagnose. Drip-proof and dust-proof, the models 40 and 41 are built to withstand rigorous industrial use. For all their power, they are battery powered, compact and easy to use.



### 701/702 Documenting Process Calibrators

Test, troubleshoot, calibrate, and document with one tool. Now with one field-tough tool you can calibrate almost any process instrument. And as you work, Fluke's new multifunction calibrators automatically document both calibration procedures and the calibration results. Technicians no longer need to juggle paper and pen to manually record data in the field, and then transcribe their handwritten notes back in the shop. Instead, information is captured automatically, saving time, eliminating errors, and ensuring consistent, repeatable results.

Following is a listing of the Fluke products and accessories available through authorized Fluke distributors and Fluke LAN tools representatives. Products are listed in alphanumeric order. For the name and location of your nearest Fluke distributor or LAN tools representative closest to you, please call 1-800-44-FLUKE.

## Index listing of other Fluke test tools

| Model | Description |
|---|---|
| **Bench Multimeters** | |
| 45 | Dual Display Multimeter |
| 45-01 | Dual Display Multimeter with Battery |
| 45-05 | Multimeter with IEEE-488.2 |
| 45-15 | Multimeter with Battery & IEEE-488.2 |
| **Documenting Process Calibrators** | |
| 701 | Process Calibrator |
| 702 | Process Calibrator |
| 702+ | Process Calibrator Plus PMLink Software |
| **Digital Thermometers** | |
| 51 | Digital Thermometers |
| 52 | Digital Thermometers |
| **Handheld Multimeters** | |
| 8 | Automotive Meter |
| 10 | Multimeter |
| 11 | Multimeter |
| 12 | Multimeter |
| 21 | Analog/Digital Multimeter |
| 23 | Analog/Digital Multimeter |
| 25 | Analog/Digital Multimeter |
| 27 | Analog/Digital Multimeter |
| 29 | Analog/Digital Multimeter |
| 30 | Clamp Meter |
| 31 | Current Master |
| 32 | Clamp Meter |
| 33 | Current Master |
| 70 | Analog/Digital Multimeters |
| 75 | Analog/Digital Multimeters |
| 76 | True RMS Analog/Digital Multimeter |
| 77 | Analog/Digital Multimeters |
| 78 | Automotive Meter |
| 79 | Analog/Digital Multimeter |
| 83 | Analog/Digital Multimeters |
| 85 | Analog/Digital Multimeters |
| 87 | Analog/Digital Multimeters |
| 88 | Multimeter for Auto Electronics |
| 863 | Graphical Multimeter |
| 865 | Graphical Multimeter |
| 867 | Graphical Multimeter |
| 8060A | 4-1/2 Digit Handheld Multimeters |
| 8062A | 4-1/2 Digit Handheld Multimeters |
| **LAN Products** | |
| 610 | CableMapper |
| 620 | CableMeter |
| 650 | CableMeter |
| 650R | Remote Unit |
| 652 | CableMeter |
| 670 | LANMeter |
| 672 | LANMeter |
| 675 | LANMeter |
| 670/BL | LANMeter, Token Ring with Backlight |
| 672/BL | LANMeter, Ethernet with Backlight |
| 675/BL | LANMeter, Ethernet & Token Ring with Backlight |
| DSP 100 | CableMeter |
| DSP 100/SR | CableMeter with Smart Remote |
| DSP-R | Standard Remote |
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| 45-05K | IEEE-488.2 Interface Kit |
| 80AK | Thermocouple Adapter Plug |
| 80CJ-M | Male Mini Connector |
| 80CK-M | Male Mini Connector |
| 80i-110s | Clamp-on AC/DC Current Probe |
| 80i-400 | Clamp-on AC/DC Current Probe |
| 80i-410 | Clamp-on DC/AC Current Probe |
| 80i-500s | Clamp-on AC Current Probe |
| 80i-600 | Clamp-on AC Current Probe |
| 80i-600A | Clamp-on AC Current Probe |
| 80i-610s | AC/DC Clamp |
| 80i-1000S | AC Current Probe for Scopes |
| 80i-1010 | Clamp-on DC/AC Current Probe |
| 80i-kW | Current Power Probe |
| 80J-10 | Current Shunt |
| 80K-6 | High Voltage Probe |
| 80K-40 | High Voltage Probe |
| 80PK-IR | Infrared Temperature Probe |
| 80PK-1 | Type K Bead Probe |
| 80PK-2A | Type K Immersion Probe |
| 80PK-3A | Type K Surface Probe |
| 80PK-4A | Type K Air Probe |
| 80PK-5A | Type K Piercing Probe |
| 80PK-6A | Type K Exposed Junction Probe |
| 80PK-7 | Industrial Surface Probe |
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| 80T-IR | Infrared Temperature Probe |
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| 80TK | Thermocouple Module |
| 83RF | High Frequency Probe |
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| AC20 | Industrial Test Leads |
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| AC75 | Banana Jack-Alligator Clips |
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| AC83 | Pin-Grabber Test Clips |
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| C800 | Hard Storage Case |
| C6700 | Soft Carrying Case (Large) |
| KIT-23 | Service Kit |
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| N6800/E | HealthScan for Ethernet |
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| PM 8906 | NiCad Battery Pack Charger |
| PM 8907 | Line Voltage Adapter/Battery Charger |
| PM 8918 | ScopeMeter/Oscilloscope Probe Set |
| PM 9080 | RS-232 Adapter Cable |
| PM 9081 | Dual Banana Plug/F BNC Adapter |
| PM 9082 | Dual Banana Plug/M BNC Adapter |
| PM 9083 | Yellow Protective Holster |
| PM 9084 | Probe/Ind Alligator Clip |
| PM 9085 | Probe Hook-Style Clip |
| PM 9086 | NiCad Battery Pack |
| PM 9087 | Auto Lighter Charge Adapter |
| PM 9090 | Probe Pin-Grabber Flex Clip |
| PM 9091 | 50 Ohm Coaxial BNC Cables |
| PM 9092 | 50 Ohm Coaxial BNC Cables |
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| PM 9094 | Probe Accessory Set |
| PM 9095 | Single Ban Jack/M BNC Adapter |
| PM 9099 | Pin-Grabber Flexible Clip |
| PM 9266 | Safety Test Leads |
| PV350 | Pressure/Vacuum Module |
| RPM 80 | Inductive Pickup |
| RPM 90 | Inductive Pickup |
| RS40 | RS-232 Terminal Interface Cable |
| RS41 | RS-232 Null Modem Cable |
| RS42 | RS-232C to Printer Cable |
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| STL90 | Shielded Test Lead Set |
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| SW90W | FlukeView for Windows |
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| TP80 | Electronic Test Probes |
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| Y8021 | IEEE-488 Shielded Interface Cable, 1M |
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| Y8140A | Test Lead Set |
| Y9108 | BNC-Banana Adapter |
| Y9109 | BNC-Banana Adapter |
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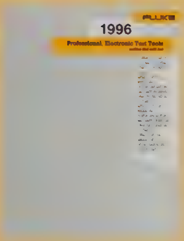

**Test Tools**
Handheld DMMs
Digital Thermometers
Accessories for DMMs & Digital Thermometers
Bench/Portable Multimeters
Graphical™ Multimeters
Scopemeter® Series II
Power Harmonics Meters
Scopemeter® Power Harmonics
Meter Accessories
LAN Cable Test Tools

**Electrical/Industrial/HVAC-R**
Clamp/Power Meters
Digital Multimeters
Digital Thermometers
LAN Cable Test Tools
Specialty Accessories

**LAN Test Tools**
Cable Mappers
Cable Meters
LANMeter Test Tools

**Automotive Test Tools**
Current Clamps
Digital Multimeters
Digital Thermometers
ScopeMeter Test Tools
Accessories

### 1996 Catalogs*

You'll be pleased to know that Fluke offers other test tool catalogs that feature the products shown in the adjoining listing and preceding pages in this section.

The different catalogs and their product category contents are shown here. As with the Instrumentation Test Tools catalog, each of these catalogs includes pictures, features, benefits, specifications and selection charts of Fluke tools. To order, please call 1-800-44-FLUKE.

* Please note that these catalogs are scheduled for production beginning in late 1995 and some may not be available at the time of your call. However, every effort will be made to provide you with a substitute catalog or selection guide including the information you are in need of.

Need Technical Assistance?
Want to know your closest source to buy these products?
Call:

**1-800-44-FLUKE**

Toll-free in the U.S.
(905) 890-7600 in Canada

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**New**

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**GPIB IEEE-488**

Indicates that an instrument is available with a GPIB (General Purpose Interface Bus)/IEEE-488 communications interface bus. GPIB is equivalent to IEEE-488/ IEC-6251.

**SCPI GPIB IEEE-488**

Indicates that an instrument is available with a GPIB (General Purpose Interface Bus)/IEEE-488 communications interface bus, and complies with the internationally standardized command language for electronic instruments - SCPI (Standard Commands for Programmable Instrumentation). GPIB is equivalent to IEEE-488/ IEC-6251.

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